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-- Via FedEx --

Mr. Ronald M. Naman, P.G.
Remedial Project Manager
U. S. Environmental Protection Agency
290 Broadway, 19th Floor
New York, New York 10007-1866

RE: Response to USEPA Comments on Phase 2 FS Report
Bridgeport Rental and Oil Services Superfund Site

Dear Mr. Naman:

On behalf of the BROS Technical Committee (Committee), Environmental Liability Management, Inc. (ELM) has reviewed the inquiries raised by the U.S. Environmental Protection Agency (USEPA), as outlined in USEPA's letter dated May 18, 2005, regarding the Draft Phase 2 Feasibility Study (FS) Report prepared for the Bridgeport Rental and Oil Services (BROS) Superfund Site. The attached response acknowledges and responds to each of the topics discussed in the May 18 letter. For ease of reference, this response letter has been divided similarly to the referenced USEPA comment letter (i.e., the first section addresses the general FS Report comments, the second section addresses the specific FS Report comments, and the third section addresses the specific presentation of pumping and oxidation approaches to deep groundwater comments). The USEPA comments are repeated in italics followed by the Committee's response. A copy of the revised FS is also enclosed for your review. Changes have been made throughout the FS, consistent with the Committee's responses to comments and discussions with the USEPA in June and July of this year. A complete set of figures, tables and plates (including several new ones) is included.

I am available to discuss any of the responses or Environmental Liability Management, Inc. revisions with you at your convenience.

Sincerely,

Peter P. Brussock, Ph.D. for
Project Coordinator

c: William Blank (w/o enclosures)
John Schenk (w/o enclosures)
Alex Polonsky (w/o enclosures)
John Loper (w/o enclosures)
John Samuelian (w/o enclosures)

FEASIBILITY STUDY REPORT

General Comments

1. *EPA has reviewed the New Jersey Administrative Code N.J.A.C. 7:26-2A.1 in regard to its application to the former hazardous waste oil lagoon and does not believe these regulations are either relevant or appropriate with respect to allowing the Settling Defendants to ignore existing shallow aquifer groundwater contamination. Therefore, language to that effect should be stricken from the FS.*

It is our understanding that 7:26-2A.1 --"Scope and Application" (c) applies to the following facilities:

1. All newly proposed sanitary landfills and all existing landfills proposing to expand their existing operations onto previously unfilled permitted areas; and

2. Any existing sanitary landfills operating as an open dump or in an evironmentally unsound manner which the Department determines needs to be environmentally upgraded.

Further, section (d) of the regulation does not apply to hazardous waste landfills. See N.J.A.C. 7:26G.

Additionally, 7:26-2A.1, entitled "Sanitary landfill environmental performance standards" provides performance standards for "any sanitary landfill subject to regulation pursuant to N.J.A.C. 7:26-2A.1(c)" (7:26-2A.6(a)) [above]. Subparagraph (c) of the regulation contains the language concerning the point of groundwater standards compliance for shallow aquifers being 150 meters from the property boundary of the landfill or 150 meters from the toe of the slope, whichever is less. To begin with, these regulations apply only to operating sanitary landfills, not to hazardous waste landfills. The lagoon is no a landfill and, further, it contains hazardous waste. Therefore, the regulations don't apply to the lagoon, which was never a "sanitary landfill," and in any case, has been closed. Consequently, EPA does not consider them to be relevant and appropriate.

Response: For clarification, the reference to the New Jersey Solid Waste (NJSW) regulations (N.J.A.C. 7:26-2A.1) as an Applicable Relevant and Appropriate Requirement (ARAR) relates to the USEPA's placement of incineration ash from the Phase 1 Remedy in the ground over 13 acres of the BROS Property in the mid-1990s. It was not intended to relate to the hazardous waste lagoon that was removed as part of the Phase 1 Remedy. The ash waste that was deposited on the property was treated prior to deposition to render it non-hazardous. Consequently, the non-hazardous ash waste deposited over 13 acres of the BROS Property is regulated by NJSW regulations that were in effect at the time the waste was placed. The FS has been revised to clarify this issue and lists the NJSW regulations as relevant and appropriate ARARs, as specifically related to the ash waste.

2. *Nowhere in the CD do we find "Lagoon Work" expressly excluded from Groundwater Work. Although EPA can't sue the Settling Defendants to pay for any "Lagoon Work" we (EPA) choose to perform, that doesn't mean we can't compel the Settling Defendants to perform "Lagoon Work." Therefore, EPA believes that the Settling Defendants, if so directed in decision documents prepared by EPA, are required to perform necessary "Lagoon Work" considered to be part of the Groundwater Work wherever found[1]. This includes the following which are also listed as exclusions in the "Lagoon Work" definition detailed in the Consent Decree: (1) D-NAPL wherever found, and (2) free product or LNAPL found either below, or floating on and moving vertically with, the water table.*

Response: As noted in the Committee's response to the USEPA comments on the RI, the question of whether Settling Defendants have a legal obligation under the BROS Consent Decree to perform or to pay for any remedial action for soils or for LNAPL is extremely important. However, this question need not be addressed in the FS Report. Accordingly, in the interest of facilitating timely completion of the RI/FS project, the Committee has removed from the draft FS Report any discussion of this question.

3. *In Section XXIII of the Consent Decree, EPA covenants not to take judicial or administrative action against the settling parties for any claims under 106, 107(a), or 113(f)(2) of CERCLA (and 7003 of RCRA, and the NJ Spill Act) relating to the Site. However, this action only becomes a complete release at the time of certification of completion of work by EPA. In addition, after the CD (OU #2) work is completed, additional work may be completed if the reopeners are triggered in accordance with Consent Decree Section XXIII.*

Response: See response to general comment #2.

4. *At various locations throughout the FS, references are made that some of the remedial action objectives (RAOs) were not achieved through the implementation of the 1984 Record of Decision (ROD). Specifically, the FS contends that "the goal of source/waste*

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[1]Subsection VII.A, Paragraph 11.a of the Consent Decree (CD), requires that "Settling Defendants shall determine the nature and extent of groundwater and other Site-related contamination, such as wetlands, currently remaining at the Site, and shall develop and evaluate the feasibility of potential remedial alternatives for mitigating any hazards or risks to public health, welfare, or the environment posed by Site contamination." (Emphasis added.) The Statement of Work, incorporated as Appendix E to the CD, states that the Aobjective of the Phase 2 RI is to determine the nature and extent of Site-related contamination in ground water, surface water, sediments, wetlands and soils remaining at the Site following the lagoon cleanup (Lagoon Work).@ (Emphasis added.) The SOW further states that the Aobjective of the Phase 2 FS is to develop and evaluate the feasibility of potential remedial alternatives for mitigating any unacceptable human health and/or ecological risks posed by the Site contamination.@ (Emphasis added.) EPA is to provide oversight of the Phase 2 RI/FS under the SOW, and Settling Defendants are required to Aprovide EPA with the necessary support to facilitate the initiation and conduct of oversight and related activities.@ (Section I, Page 3.)

removal to protect groundwater was not fully achieved." The implementation of the 1984 ROD included the removal and treatment of over 90 percent of the contaminated mass in soil. However, when screening technologies for shallow soil, LNAPL, and shallow groundwater for inclusion in the remedial alternatives, the BROS Technical Committee contends that many remedial technologies should not be considered because "horizontal movement of LNAPL and COPCs in shallow groundwater is not significant and will remain so in the future." This is the rationale for not including many remedial alternatives for soil, LNAPL and shallow groundwater in the detailed evaluation (see General Comment #8 for additional details). If the BROS Technical Committee is contending that the RAOs for protection of groundwater were not achieved when implementing the 1984 ROD, then additional active remedial alternatives for soil, LNAPL and groundwater must be included in Section 2 of this FS. Further, an evaluation characterizing the 90 percent removed and the remaining 10 percent of the contaminated mass of oil, soils and sludge should be presented.

Response: Consistent with discussions with the USEPA in June and July 2005, the Committee has prepared a more detailed analysis of remedial alternatives that would restore additional ground water, including an extended duration of bioslurping, thermal treatment and other remedial alternatives that were provided to the USEPA as a Technical Memorandum (June 21, 2005). That analysis was found to be acceptable to the USEPA and the Committee agreed to incorporate the Technical Memorandum into the text of the revised FS Report (and in part as an Attachment). In addition, a new alternative has been added to the detailed analysis of LNAPL alternatives.

5. *PRGs for soil or groundwater are not identified in Executive Summary or the main body of the Draft FS Report. Although the human health and ecological risk assessments are referenced, actual PRGs and associated concentrations used as a threshold for estimating contaminated areas and volumes should be provided.*

Response: Concentration specific PRGs for soil, LNAPL and ground water have been added to the revised FS Report (Tables 2-2, 2-3, and 2-4).

6. *The Remedial Investigation/Feasibility Study guidance document (USEPA, 1988), Section 4.2.1 (Develop Remedial Action Objectives) requires that "remedial action objectives be developed, including contaminants and media of concern, exposure routes and receptors, acceptable contaminant level or range of levels for each exposure route." Although references are made in the RAOs to remediate to either site-specific risk levels (for soil) and the Groundwater Quality Standards (GWQS) or the Federal Maximum Contaminant Limits (MCLs) (for shallow groundwater), a comprehensive list of Preliminary Remediation Goals (PRGs) has not been included in this FS. In accordance with EPA guidance, PRGs should be established based on readily available information (such as human health and ecological risk values) or chemical-specific ARARs, such as the Federal MCLs, the USEPA Region 9 Tap Water PRGs, the USEPA Soil Screening Levels (SSLs), the New Jersey Department of Environmental Protection (NJDEP) Soil Cleanup Criteria (Table 3-2 and 7-1 from the February 3, 1992 proposed rule entitled Cleanup*

Standards for contaminated Sites N.J.A.C. 7:26D), and the NJDEP GWQS (N.J.A.C. 7:9-6). These PRGs should be broken down by media and COC. These PRG values are important to understand final remedial goals, defining the area exceeding PRGs, and time frame to achieve PRGs. Also, after the identification of applicable PRGs that will be the remediation goals, a figure or series of figures should be generated illustrating the area exceeding PRGs in each media. It has been presumed that these figures have been generated since impacted volumes are included in Table 2-2, however, these figures have not been included in the FS.

Response: PRGs have been broken out by media and COC (Tables 2-2, 2-3, and 2-4). Existing FS Figures 1-3 and 1-4 and Plates 2 through 5 figures illustrate the distribution of COCs exceeding these PRGs in soils and LNAPL, respectively. Plate 7 has been added to the FS Report to provide supplemental information regarding the distribution of LNAPL. Figures 3-16, 3-17, and 4-10, as well as Plates 8, 9 and 10, of the RI Report provide detail with regard to the distribution of COCs that exceed PRGs in ground water. Existing FS Figures 1-1, 1-5, and 1-13 show the general distribution of COCs that exceed PRGs in ground water. The Classification Exception Area/Well Restriction Area (CEA/WRA) Report (Appendix T of the RI Report) also provides information with regard to the COC distribution in ground water. See response to specific comment #21 also.

7. *Throughout the FS, the list of contaminants detected in soil and groundwater are referred to as "Contaminants of Potential Concern". Based on the extensive investigation and remedial actions completed at the site, including human health and ecological risk assessments, it has been concluded that these compounds are not contaminants of potential concern, but are the Contaminants of Concern (COCs) for the site. In accordance with the Remedial Investigation/Feasibility Study guidance document (USEPA, 1988), when RAOs are developed, the COCs for each media should be outlined. Therefore, these compounds should be referred to as COCs in the FS.*

Response: Revisions have been made throughout the FS Report consistent with the comment.

8. *In Section 2 of the FS Report, various remedial technologies were screened for inclusion into remedial alternatives for soil, LNAPL, and shallow groundwater. Many of these technologies were not retained for inclusion into remedial alternatives for various reasons. Details for not including specific technologies within alternatives were generally due to difficulties with implementation, and/or high implementation costs. Based on this initial screening, it does not appear that a representative evaluation of a full range of alternatives for soil, LNAPL, and shallow groundwater have been included in the FS. In the Remedial Investigation/Feasibility Study guidance document (USEPA, 1988), Section 4.1.3, "Alternatives should be developed that will provide decision-makers with an appropriate range of options and sufficient information to adequately compare alternatives against one another." While implementation and cost are two of the initial evaluation criteria for technology groups and alternatives, the elimination of all potential alternatives that include these technologies does not provide a full range of alternatives for the impacted media.*

Response: See response to general comment #4.

9. *In Section 3 of the FS, the focus of the development and screening of alternatives is for deep groundwater at the site. The two target areas in deep groundwater (designated as the Principal Threat Zone [PTZ] and the downgradient groundwater) are referenced as the extent defined in the Phase 2 RI Report. For ease, these figures should be included in the discussion of the RAOs, PRGs, and areas exceeding PRGs in Section 3.1. Note that the discussion of the PTZ should include all of the COCs seen in deep groundwater exceeding PRGs.*

Response: References to figures illustrating target areas for remediation have been added to the RAO section. In addition, consistent with the CEA/WRA, text tables that list all chemicals that exceed the PRGs in ground water are contained in Sections 5.3.5.2 and 5.3.5.3 of the RI Report.

Further, the restoration pumping alternatives (Alternatives 2A and 2B) were screened out based on difussion-controlled COPC extraction rates which are comparable to natural attenuation (degradation) rates and certain administrative challenges which would slow implementation. However, EPA does not believe that these comparisons are without question. Therefore, a detailed analysis of at least one restoration pumping alternative is necessary.

Response: Alternatives 2A and 2B were not carried forward to the detailed alternative analysis based on their substantially lower scores compared with other alternatives using the five CERCLA screening criteria. However, as a result of discussions with the USEPA (June 28, 2005 meeting), the pumping and treatment component of the two phased alternatives (DGW-6 and DGW-7) was substantially expanded to include areas surrounding the PTZ (Low Threat Zone – LTZ) for COC mass removal, which is evaluated in the detailed analysis.

10. *The Draft FS Report, similar to the Draft RI Report, characterizes groundwater flow in the Water Table/Upper Potomac Raritan-Magothy (PRM) Aquifer as predominantly downward over the course of lagoon operations and under present hydrologic conditions. While a characterization of predominantly vertical flow (downward) in the Water Table/Upper PRM Aquifer appears to be one interpretation of groundwater flow conditions, there does seem to be some data to support other potential scenarios. These scenarios should be addressed in the FS.*

Response: The discussion of ground water flow has been expanded and revised consistent with the similar changes in the RI.

11. *It is unclear throughout the FS which COCs were used to designate the extent of the PTZ area in deep groundwater. In Section 1.3.5.4, it states that the PTZ is defined as the area with TCE and benzene over 1,000 ug/L. This is also illustrated in Figures 1-13, 1-14, and 1-19. However, in Section 3.3.2.1, it states that the PTZ "is characterized by the*

presence of chlorinated VOCs (2,000 ug/L to 10,000 ug/L), BTEX (up to 4,000 ug/L), BCEE (up to 3,800 ug/L), pH as low as 2.8, and high iron and sulfate concentrations." The latter designation of the PTZ appears to be the more comprehensive evaluation of the PTZ and should be consistent throughout the FS. This includes adding the concentrations of these compounds to the figures designating the PTZ (Figures 1-13, 1-14 and 1-19).

Response: The definition of the PTZ has been made consistent and more clear in the FS. Noteworthy is that the PTZ in the FS is defined by boundary conditions (CVOCs = 1,000 ug/L; pH = 5) and described by the range of conditions within the boundary. The CVOC level of 1,000 ug/L ensures the area with the most COC mass is evaluated for treatment while the other limitation of pH 5 ensures the area with diminished biodegradation capacity is evaluated separately. In addition, below pH 5 is where Fenton's reagent reacts efficiently with COCs.

12. *Monitored natural attenuation (MNA) has been retained as a potential technology for the downgradient portion of deep groundwater. However, no information as to decay rates for all COCs has been included in the FS to (1) demonstrate the effectiveness of MNA and (2) to determine the time-frame required until COCs will reach PRGs. This evaluation should be completed for all COCs to determine if MNA is a viable technology that should be retained for inclusion in remedial alternatives for deep groundwater.*

Response: Consistent with discussions between the Committee (and its representatives) and the USEPA in June and July 2005, the MNA supporting information and analysis has been augmented within the RI and to a lesser degree in the FS, recognizing that substantial additional information will be collected in the upcoming years and any decision to select MNA as a component of a remedy would include a provision for a contingent remedy should MNA be found to be insufficiently protective of human health and the environment.

13. *In Section 3, the retained remedial alternatives for deep groundwater are evaluated against the nine NCP criteria. When comparing each of the remedial alternatives for the "Reduction of Mobility, Toxicity, and Volume through Treatment" criteria, there is no mention of the mass reduction amounts for each of the retained alternatives. The volume of reduction (in pounds, gallons, etc.) should be presented to aid in the evaluation of each alternative against the others. Note that generally MNA is not considered an active treatment alternative that reduces the volume of contaminant mass.*

Response: The Committee has added some additional discussion of the relative mass reduction of the alternatives considered in the detailed analysis. Discussion of relative mass reduction was included in the initial draft of the FS Report on pages 3-96 (DGW-2), 3-99 (DGW-3), 3-112 (DGW-4), 3-115 (DGW-5), 3-122 (DGW-6), and 3-126 (DGW-7). In addition, quantified mass reduction analysis was included in the analysis of pumping and treatment versus chemical oxidation (See Attachment 1 of December 20, 2004 FS Report draft). Further quantification of the mass reduction associated with each alternative is not readily achievable, due to uncertainties regarding the effectiveness of various technologies proposed that would be substantially reduced through treatability or pilot studies. Nonetheless, the Committee regards the comparative mass reduction analysis presented in the revised document as clearly sufficient to support the completion of the alternative analysis. Regarding the comment that "MNA is not considered an active treatment alternative", the Committee notes that USEPA guidance (OSWER Directive 9200.4-17P (1999) and; USEPA, 1998d) clearly state MNA is not to be viewed as a "no-action" or "walk" approach but an active treatment alternative.

14. *In many of the remedial alternatives for deep groundwater in Section 3, one component is for the use of enhanced biological degradation along the downgradient portion of the plume. These alternatives (DGW-3, 5, and 7) include the installation of wells downgradient of the PTZ for injection of oxygen and nutrients to enhance biodegradation. While this may be a viable technology for in-situ treatment of the COCs in deep groundwater based on the treatability testing, it does not appear that the delivery of these compounds at the locations proposed will address the entire length of the downgradient plume. If the additive is delivered into the upgradient portion of the plume, there is no discussion if these compounds will be depleted prior to reaching the edge of the area exceeding PRGs. As the alternatives are currently proposed, it appears that no active treatment of the area south/southeast of Interstate I-295 will be completed. A more robust delivery system for oxidant chemicals (potentially through the installation of a series of wells parallel with the primary groundwater flow direction) is necessary to meet RAOs for the groundwater downgradient of the PTZ.*

Response: The conceptual design and costing analysis for downgradient enhanced biodegradation alternatives has been modified to ensure application of the technology across the width of the plume. The factors related to the application of the technology over the entire length of the plume are discussed in Sections 3.4.2.2, 3.4.2.6 and 3.5.3.5, including inaccessibility of many areas where wetlands and I-295 overlie the plume. The text has been revised to include more detailed consideration of the rate of depletion of enhancement in the remedial design. However, the primary objective would be to decrease the concentrations in the vicinity of I-295 resulting in lower mass loading to the downgradient area where natural attenuation processes will address the remaining COC residuals.

15. *The FS repeatedly overstates the importance of the diffusion of contaminants of potential concern (COPC) from fine-grained, low permeability units (clays, silts) to coarse grained, higher permeability units in the Upper Middle PRM Aquifer. Subsequently, extraction alternatives are routinely dismissed as effective methods for reducing contaminant mass. Over the course of the Phase I or Phase II Remedial Investigation, many soil samples collected from the clay lenses, or basal clay unit between the Upper Middle and Lower Middle PRM aquifers exhibited concentrations of COPCs below laboratory method detection limits (MDL). Thus, evidence of COPCs sorbed or diffused into the finer grained units appears to be less significant than stated. In the PTZ, aquifer materials in the Upper Middle PRM Aquifer exhibit high permeability and should facilitate the rapid removal of contaminant mass by advective flushing. Additional detail is necessary to understand the diffusion rates from fine-grained materials and their*

potential impact on the various chemical and biological treatment technologies being proposed.

Response: The technical literature (Mackay and Cherry, 1989, and references therein) and USEPA guidance (USEPA, 1996. Pump and Treat Ground Water Remediation. A Guide For Decision Makers and Practitioners, and references therein) are consistent in supporting a conclusion that under the conditions at the BROS Site (Attachment 2, formerly Attachment 1; Pages 6 and 10), diffusion of COCs from fine-grained, low permeability strata into high permeability strata will occur slowly and render pumping and treatment ineffective at restoring the aquifer. Contrary to the comment that the "Extraction alternatives are routinely dismissed as effective methods for reducing contaminant mass," two of the alternatives in the detailed analysis (DGW-6 and DGW-7) include pumping and treatment components for mass reduction. In addition, pumping and treatment mass reduction has been expanded to the area surrounding the PTZ (defined as the Low Threat Zone (LTZ)) in both of those alternatives. Pumping and treatment was screened out only as a stand-alone alternative for aquifer restoration, consistent with the NCP (40 CFR Part 300, March 8, 1990) literature, guidance, site conditions and the FS alternatives analysis.

16. *In contrast to previous general comments, hydrodynamic drawbacks to injection-type technologies/alternatives (in situ chemical oxidation (ISCO) and enhanced aerobic biodegradation) are not discussed. In porous media, injected fluids may drive contaminated groundwater away from the intended treatment zone rather than mixing between the fluids throughout the zone. Although treatment occurs at the interface between the treatment fluid and contaminated groundwater, a large portion of the contaminated groundwater is displaced out of the zone of treatment. Eventually, contaminated water displaced upgradient flows back into the treatment zone with ambient groundwater flow. However, this may not have positive impacts on downgradient contaminated media which also require treatment.*

Response: The Committee did take into account that injected fluids will displace ground water. For example, pumping (and treatment) facilitated ISCO (PTZ) and enhanced biodegradation (LTZ) application is included as an alternative. Additional discussion of this consideration has been added to the text for both ISCO and in-situ biodegradation.

17. *In Section 3 of the FS, a two-tiered evaluation of alternatives was completed for deep groundwater as an initial screening process. After the initial screening of these alternatives, the main technologies for retained alternatives for each area include: (1) in-situ chemical oxidation and groundwater pump and treatment (containment) for the PTZ, and (2) enhanced biodegradation and MNA for the area downgradient of the PTZ. During the ranking of alternatives in Section 3.4 to determine which alternatives would be retained for detailed evaluation, the overall pumping alternatives (Alternatives 2 and 3) were eliminated. Also, all of the alternatives with downgradient pumping (Alternatives 4A and 5A) were eliminated, even though they ranked higher than some that were retained for the detailed evaluation. The range of alternatives for the PTZ and downgradient do not appear to include a range of alternatives such as complete*

treatment or removal of impacted groundwater. At a minimum, at least one alternative that aggressively removes the contaminant mass in the PTZ and one alternative that pumps and treats groundwater downgradient of the PTZ should be included in the evaluation, as these alternatives would most likely be more protective of human health and the environment since they would aggressively remove the entire contaminant mass.

Response: The revised FS contains two remedial alternatives (DGW-6 and DGW-7) with substantially expanded pumping and treatment in Deep Ground Water beneath and adjacent to the BROS Property, consistent with the June 28, 2005 meeting with the USEPA. As discussed in section 3.4.2.2, there are several factors that supported the screening out of downgradient pumping and treatment, including, but not limited to:

- Effectiveness –pumping and treatment may be effective in reducing mass in select areas but is ineffective as a stand-alone remedy in achieving full aquifer restoration;
- Implementability – a major issue due to access restrictions caused by large wetland areas and I-295;
- Protectiveness – there are no current or projected potentially complete exposure pathways, which may warrant a pumping and treatment approach to the downgradient area;
- The undesirability of pumping and treatment in a critical aquifer area, considering the difficulties of reinjection, when non-pumping/combined source management alternatives for downgradient areas can achieve the same PRGs; and
- The costs of restoration pumping and treatment in the downgradient area would be grossly excessive in comparison to other alternatives considering the logistics, property access and acquisition, expansive area over 100 feet deep where COCs exceed PRGs, high treatment costs due to high iron and manganese, and the enormous volume/extended period of pumping and treatment.

In addition, the specific statement in Comment #17 that alternatives with downgradient pumping (alternatives 4A and5A) were eliminated, even though they ranked higher than some that were retained for detailed analysis, is misleading and out of context of the comparative analysis.

- 4A scored a 24, only slightly higher than No Further Action and approximately equal with the two containment alternatives 2A – 24 score and 2B – score 23. The discussion at the end of section 3.4.2.13 explains why 2A and 2B were retained for detailed analysis after a June 2004 meeting with USEPA staff, management and consultants.
- 5A scored a 31 but significantly less than 5B (36 score) or 5C (36 score) which considered the tradeoffs between downgradient pumping and treatment (5A) versus enhanced biological degradation (5B) or MNA (5C), when paired with upgradient source area treatment. 5B and 5C were therefore retained over 5A.

18. *It is not evident if the detailed, and calibrated groundwater flow and contaminant transport model developed during preparation of the RI Report was utilized during the Draft FS to evaluate the spacing, number of, or flow rates for injection or extraction wells utilized in the shallow or deep groundwater alternatives. In nearly all cases, the number of extraction/injection wells included in the alternatives appears to be based on professional judgment. At a minimum, the model should have been used to determine the number of wells required to achieve containment around the PTZ.*

Response: Preliminary analysis of the spacing, number of wells and flow rates utilized the RI modeling. However, the conceptual design was based on calculations specific to the conditions under consideration, taking into account details not readily incorporated into the RI model. The sequence of the analysis was used to support the analysis of alternatives. Additional utilization of the RI modeling would likely occur as part of the remedial design/pilot studies process where iterative calculations are needed to fine tune the design. As noted in Section 3.3.3.3 of the revised FS Report, the model was utilized to determine the pumping rates for PTZ containment.

19. *Although several generalized conceptual cross-sections are included in the FS to support conceptual understanding of contaminant migration at the base of the Upper Middle PRM Aquifer, no figures are provided to support the soil/hot spot, LNAPL, shallow groundwater or deep groundwater alternatives. Figures should be provided to illustrate the location of important elements of remedial alternatives on the site including excavation cut lines, boundaries of caps or cover, extraction wells, injection wells etc. The FS should be revised to include at least a single figure for each alternative that is carried to the final round of evaluation with the nine NCP criteria.*

Response: The following figures and plates illustrate the past and current COC movement and distribution in hot spots (Figures 1-3 and 1-4), LNAPL (Figures 1-2 and 1-6; Plate 1-5) and Shallow Ground Water (Figures 1-1, 1-5 and 1-8). Plate 6 shows the proposed cover and drainage improvements. A new plate (provided to USEPA in March, 2005; Plate 8) illustrates the conceptual design of bioslurping systems. Figure 3-10 shows the conceptual distribution of Deep Ground Water injection and extraction wells. New figures (3-6, 3-7, 3-8 and 3-9) illustrate the conceptual design of the pumping and treatment system and the distribution system for the enhanced biological degradation system.

20. *Costs - In accordance with A Guide to Developing and Documenting Cost Estimates During the Feasibility Study (USEPA, July 2000), costs should be broken down into capital, annual operations and maintenance, and periodic costs. In the detailed costing tables included in the FS, there are no periodic costs included in the tables. It is noted that many of the costs that would be considered "periodic costs", (such as equipment replacement) are included, but others are not currently included (such as five-year reviews).*

Response: In accordance with the Phase 2 RI/FS Work Plan (Roux, 1999a, b, and c), the Phase 2 FS was performed consistent with the provisions of the USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988). The BROS

Technical Committee in developing the Phase 2 FS, however, utilized and incorporated more recent USEPA FS guidance, including *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (USEPA, 2000). The BROS Technical Committee included the costs that would typically be categorized as periodic costs (as listed below). Although not explicitly called out as periodic costs, they were included in the FS remedial alternative cost estimates; as indicated below:

- Performance monitoring (sampling and analysis) – *Operation and Maintenance (O&M)*;
- Reporting, ongoing project management and technical support – *O&M/monitoring*;
- Subsequent ISCO, nutrient, and NaOH injections – *capital*;
- Co-substrate (methane) additions – *contingency*;
- Well abandonment and installation (contingency wells) - *capital*;
- Replacement equipment and parts – *O&M*;
- Sludge disposal – *O&M*;
- Site evaluations and inspections – *O&M/monitoring*; and
- Site closure and de-listing of the BROS Site – *combined approach/illustrative spending schedule.*

No change to the format of remedial alternative cost tables or related FS Report text is warranted.

21a. In accordance with A Guide to Developing and Documenting Cost Estimates During the Feasibility Study (USEPA, July 2000), Section 4.1 states that "The period of present worth analysis should not necessarily be limited to the commonly-used assumption of 30 years." Each of the alternatives for deep groundwater in Section 3 of this FS are assumed using a 30-year life cycle. In most, if not all of the alternatives evaluated, groundwater will remain at the site with concentrations exceeding PRGs for some time, and in many instances over 30 years. Therefore, additional groundwater monitoring and five-year reviews, at a minimum, will still be required. Additional justification as to the remedial time-frames for each alternative should be included and the present worth evaluation of the alternatives should be changed accordingly.

Response: In accordance with the Phase 2 RI/FS Work Plan (Roux, 1999a, b, and c), the Phase 2 FS was performed consistent with the provisions of the USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988). The 1988 RI/FS Guidance specifies a 30-yr. timeframe for costing/present worth analysis. While the BROS Technical Committee considered more recent USEPA FS guidance, such as *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study* (USEPA, 2000), which suggests that 30 years may not be appropriate for all situations; considering the aggressive and integrated remedial program suggested for the BROS Site in the Phase 2 FS, it is likely that 30 years may actually overstate the timeframe for site closure. In any event, the Site will likely be in the monitoring phase 30 years out from the ROD. Based on the detailed analyses conducted during the FS, it is reasonable to assume that any of the remedial alternatives presented will not continue longer than 30 years.

21b. *The grouping of alternatives for soil, LNAPL and shallow groundwater make it difficult to compare the costs when selecting one remedy for each media. For instance, all three include cost items for phytoremediation and institutional controls. Soil and LNAPL alternatives both include costing for cover and drainage improvements. While it is understood that the authors wish to convey that certain elements will effect multiple media, this can be reflected in the text. The alternatives and the costing should be structured so that the selection of one alternative for each of the three categories can lead to a quick understanding of the total costs - simply by adding the costs of the alternatives.*

Response: As noted throughout Section 2 of the FS, soils, LNAPL and Shallow Ground Water are highly interrelated because of past operations and remedial actions. The Committee is not merely conveying that certain elements will affect multiple media, but that certain elements are independently applicable to each medium, such as cover and drainage improvements. Nonetheless, the Committee has reformatted the cost presentation to make the costing of each element more apparent.

Table 2-16 was added to the FS Report to provide the USEPA with a better understanding of the remedy components in common between the various remedial alternatives for soil, LNAPL, and Shallow Ground Water. These tables were developed in a manner such that the major cost elements for each remedial alternative are evident and a side-by-side comparison can be conducted by the reader.

22. *The report needs to include better descriptions of the layout of each remedy element and how they would interact. This should include figures which show the locations of, for example, tree planting or bioslurping points. The remedial elements should also be presented with the relevant site data, showing how the extent of a remedial element match with or address contamination. For example, show where phytoremediation would occur with data on the nature and extent of the shallow residual NAPL and shallow groundwater concentrations; show the areas of free phase NAPL with the bioslurping locations.*

Response: The Committee has made revisions to further describe how the various remedy elements would interact. Plate 7 has been added to show locations of bioslurping points (provided in draft to USEPA in March 2005) in relation to free and residual LNAPL. As described in the text, the phytoremediation would take place where free or residual product occurs. Phytoremediation would initially be applied outside the areas of active LNAPL recovery and then in the same areas as the bioslurping (active product recovery). The final design of tree placement would depend on the outcome of bioslurping work. Section 4 specifically addresses the interaction of remedy elements. Figure 4-1 illustrates the potential sequencing of remedy components.

23. *The relationship between NAPL and groundwater concentrations needs to be better presented in order to evaluate alternatives for these media. This is one of the weaknesses*

of the RI. Given the presence of residual NAPL to depths of up to 40 feet and the goal of eliminating or mitigating groundwater impacts, the selection of the best alternatives may be significantly influenced by this interplay. For instance, if areas of free NAPL are the only major sources to groundwater, then this could influence the focus of remedial efforts. If residual NAPL at greater depths is also having a significant impact, treatment of shallow residual NAPL (which is more accessible) may have less overall value.

Response: There are several figures in the RI Report that illustrate the distribution of COCs in relation to LNAPL. Although the Committee feels it is redundant with the RI document, a few of these figures have been added to the FS Report. Regarding the impact of the residual LNAPL that remains at significant depth beneath the incineration ash and former lagoon, the mass loading of COCs from these areas will be better understood after the implementation of remedial actions to address the free LNAPL around the water table. Detailed investigation of the conditions beneath the former lagoon was not supported by the USEPA during the site characterization activities. Based on the modeling of existing COCs in Shallow Ground Water (Figure 1-8, Section 1.3.5.4), COCs from the residuals beneath the former lagoon will attenuate to NJGWQS before extending beyond the BROS Property or the 150 foot setback from the incineration ash as set by the New Jersey Solid Waste Regulations. As it is impracticable to remove the residual LNAPL left behind by the USEPA beneath the ash and the water table, some localized areas of non-attainment with NJGWQS is likely. However, the New Jersey Solid Waste regulations preclude use of ground water below a solid waste landfill.

24. An alternative that includes heating or more dynamic flushing of pooled LNAPL should be fully evaluated. These technologies are eliminated early in the FS, but they could result in significant enhancement of NAPL recovery, as well as an attendant reduction in the impacts to groundwater. More agressive source removal may also provide benfits in terms of overal cost-effectivness, even though it may require a larger expenditure of funds early in the implmentation process. It is not appropriate from consideration based solely on higher front-end costs. In this case, technologies are available to more agressively address these highly-contmainated source materials and they need to be evaluated.

Response: The Committee has addressed this request from the USEPA, see response to general comment #4.

25. Natural attenuation was not sufficiently documented in the RI. Until the data are adequately presented so as to give a clear justification for NA, it is not possible to evaluate it as an element of remedial alternatives.

Response: Consistent with discussions with the USEPA in June and July 2005, the RI was revised to further evaluate the ongoing natural attenuation processes. In addition, as a provision to detailed consideration of natural attenuation in some areas, substantial additional natural attenuation monitoring and analysis would be completed early in the remedial process, as noted throughout the relevant sections of the FS.

26. *The text frequently describes the plume as 'stable and shrinking.' The plume cannot be both stable and shrinking. In the RI, modeling was used to argue that the plume is shrinking, but many of the assumptions were subject to considerable uncertainty. There is no empirical evidence that concentrations have declined - and the model is not conclusive. Subsequently, remedial options should not be framed in the context of a shrinking plume. Existing evidence suggests that, at best, we can conclude that the plume is neither rapidly expanding, nor rapidly shrinking.*

Response: The Committee has further clarified in the RI and FS Reports that the plume is composed of several COCs, some of which move and attenuate somewhat independently of each other. Therefore, the distribution of some COCs can be stable (equilibrium with sources) and others shrinking because of differing source conditions. Based on empirical trends and ground water modeling presented in detail in the text and on figures in the RI, there is no evidence to suggest the distribution of COCs in ground water is increasing. To the contrary, the evidence supports a conclusion of decreasing distribution, which is consistent with the age of the release, the subsurface conditions and the COCs.

27. *Aerobic biological enhancement is carried through in a number of the alternatives. While the text argues that this was shown to be effective in the treatability work, comments on that document indicated that the results were inconclusive for BCEE. In addition, co-metabolism of TCE has not been shown to be viable and is often not a robust process. Because of these issues, aerobic bioenhancement is not suited for treatment of the entire suite of contaminants and its continued advancement is questioned. Unless combined with other alternatives which address COCs which it cannot treat, it should be screened out earlier in the process.*

Response: The analysis of aerobic biological degradation and enhancement was expanded in the RI and FS Reports, taking into account additional relevant literature applicable to BROS. Based on these revisions and the commitment to long-term monitoring and assessment, the Committee has retained aerobic biological enhancements.

28. *The presentation of oxidation approaches to deep groundwater elicits some significant concerns. Details are provided in specific comments on Attachment 1. The problems lie in a number of aspects of the proposed approach. They range from delivery, to longevity of the oxidant selected, to the area treated, to the efficacy of low level pumping as an enhancement. Taken together, the overall viability of the approach laid out is questionable. It may be that with significant enhancements to the approach, oxidation may prove a viable remedy element, but as presented, the likelihood of it achieving the predicted results is in doubt.*

Response: As discussed with the USEPA at the June 28, 2005 meeting, the in-situ chemical oxidation (ISCO) remedy component is well suited for the Site conditions and to address USEPA's concerns has been upgraded to ensure a high level of effectiveness. The specific design of the iterative application of ISCO would be developed through the use of pilot studies.

SPECIFIC COMMENTS:

1. *Page iv, fifth bullet: Deep groundwater would also include AOC-3. Although this is being treated as a source area, it does contain groundwater which needs to be addressed.*

Response: Agreed. The text has been revised and clarified accordingly.

2. *Page iv, seventh bullet: As noted above, it has not been conclusively shown that the plume is shrinking. This has been modeled but there is no empirical data that shows this.*

Response: The bullet was revised from "slowly shrinking" to stable with some COCs decreasing in distribution, consistent with the response to general comment #26.

3. *Page v, first paragraph: The statement that all potential exposures are incomplete is not accurate. Volatile organic emissions, even for slab-on-grade construction will need to be considered. This is further noted on page 1-39. Discharge to surface water is another consideration which need to be addressed.*

Response: This statement refers to current conditions. The FS Report also addresses potentially complete pathways that may exist in the future.

4. *Page vi: The reference "NRC, 2003" is not included in the references. Please add it.*

Response: The reference has been checked and found to be present. The references in the revised document will also be checked.

5. *The first twelve pages of the executive summary appear to be a set up for the alternatives that are favored by the authors and do not really summarize the document. This is inappropriate. The summary should briefly and objectively present the document and remedial alternatives. These pages should be deleted.*

Response: As discussed with the USEPA RPM on July 13, 2005, the Committee has prepared a highly site-specific evaluation, based on a careful analysis of the relevant site features and most recent technical guidance and literature, taking into account the Phase 1 RI/FS and remedy. The first twelve pages of the executive summary convey the process of the analysis, listing key site features and the results of that analysis. Therefore, no revisions to the executive summary have been made based on the comment.

6. *Page 1-7, Section 1.1, Paragraph 1, "Objectives of 1984 Phase I ROD": The first sentence states that, "In general, the objective of Phase I remedial action (lagoon work) was to protect ground water from sources of contamination..." While this was one of the primary objectives of the 1984 ROD, in the "Future Actions" portion of the 1984 ROD, it states that additional contamination may remain after the excavation completed in 1984 (due primarily to the potential presence of additional contamination under the sludge waste oil), then, "The need for a second excavation phase will be assessed in a study*

which will determine the cost effectiveness of additional excavation." *As discussed in prior general comments, there has been no additional or follow-up evaluation of potential excavation within the FS for impacted soils investigated after the implementation of the 1984 remedial actions. This should be included within this FS to provide for a full range of remedial alternatives for these media.*

Response: The draft FS Report does include evaluation of potential excavation for impacted soils (see Section 2.3.1) and LNAPL (see Section 2.3.2). However, the comment "The need for ... additional excavation" is presented out of context. The last sentence of the same paragraph notes "The second phase analysis will be conducted during the sludge excavation and disposal phase so any additional remedial measures can be implemented immediately following the first phase excavation." Clearly, the intent was to complete the excavation work prior to backfilling the former lagoon, including placement of incineration ash over the top of lagoon residuals. The sludge excavation and disposal phase was completed over eight years ago.

7. *Page 1-4, Section 1.1, Paragraph 2. Word missing: The sentence should read: As identified during the scoping of the RI and throughout the Phase 2 RI.*

Response: Agreed.

8. *Page 1-11, Section 1.1, Paragraph 1. Typographical error: Should be "removed, or remediated ..."*

Response: Agreed

9. *Page 1-12, Section 1.1, Paragraph 2: Records, in addition to water quality analysis from the Phase I and Phase 2 RI efforts should be presented that indicate that a sulfuric acid spill in the BROS lagoon is the sole cause for the migration of COPCs to the base of the Upper Middle PRM Aquifer. The presumed occurrence of a spill, and its estimated timing, exert significant influence on the development of remedial alternatives for the deep groundwater.*

Response: References to the relevant depositions of plant managers and employees in this regard have been added, consistent with the timing of the spill assumed the in the fate and transport analysis.

10. *Page 1-30 and 1-40, Section 1.3.4.4: The text here mentions several technologies for addressing LNAPL at the site, such as thermal techniques, oxidation etc. These technologies are discounted in favor of phytoremediation and bioslurping based on a lack of significant migration of the LNAPL. However some migration of LNAPL has been observed along the perimeter of the former lagoon which has allowed for off-property migration. In any case, the goal should be reducing the amount of free product to the extent practicable. Whether or not the LNAPL is migrating or not does not have any implication in reviewing the technologies available. Also, this discussion does not belong in the introduction of the document. The title of this section is Additional Ground*

Water Characterization and Treatability Study Results. Discussion of applicable technologies does not belong here. Please delete this discussion.

Response: Discussion of remedial technologies has been deleted from 1.3.4.4 as it is redundant with discussion and analysis in Chapter 2.

11. *Pages 1-27, Section 1.3.4.1, Paragraph 1: A map in the FS should be referenced displaying the aerial extent and depth of LNAPL in Hot Spot 1, Hot Spot 2, and the PZ-4 area from which the table on Page 1-27 is derived. The estimated masses of COPCs in the table should be substantiated.*

Response: Plates 2 through 6 of the revised FS Report provide the requested information on aerial extent and depth. The estimated masses of COCs are detailed in Appendix U of the RI Report, as referenced in the revised FS Report.

12. *Page 1-30, Section 1.3.4.4, Bullet 2: The FS should identify the health based standards and criteria that COPC concentrations decline below after migrating a short distance from source areas in the Upper PRM Aquifer.*

Response: Agreed; the health-based standards and criteria include the NJDEP GWQS and Federal MCLs.

13. *Page 1-35, Section 1.3.5.4, Paragraph 1: This sentence states that the PTZ is defined as the area "of elevated COPCs and low pH". In Section 1.3.5.4, it states that the PTZ is defined as the area with TCE and benzene over 1,000 ug/L and in Section 3.3.2.1, it states that the PTZ "is characterized by the presence of chlorinated VOCs (2,000 ug/L to 10,000 ug/L), BTEX (up to 4,000 ug/L), BCEE (up to 3,800 ug/L), pH as low as 2.8, and high iron and sulfate concentrations." As discussed in the general comments, the PTZ should be defined by the elevated concentrations of chlorinated VOCs and the areas with concentrations of BCEE that may be a principal threat to human health and the environment. Note that this addition may not change the extent of the PTZ, but only designate that the majority of the BCEE mass is within this area and will be considered during the evaluation of remedial alternatives for the PTZ.*

Response: See general comment #11.

14. *Page 1-36, Section 1.3.5.4, Item 5: No definitive evidence, other than modeled projections, has been provided to indicate the contaminant plume in the Upper Middle PRM Aquifer is shrinking. Evidence of a shrinking plume must include time-related concentrations of COPCs at individual wells, at multiple wells along the axis of the plume, or at the leading edge of the plume.*

Response: The requested information is provided in Section 5.4 of the RI Report and data/analysis referenced therein.

15. *Page 1-36, Section 1.3.5.4, Item 6: This paragraph states that "The primary COPCs of concern in the Upper Middle PRM are chlorinated organics and benzene..." However, in this same paragraph, it states that "BCEE was detected with concentrations ranging from 9 ug/l to 3,800 ug/l." BCEE should also be considered a primary COC for the deep groundwater.*

Response: BCEE is a "chlorinated organic" and is considered a primary COC throughout the FS Report.

16. *Page 1-38, Section 1.4.1, Paragraph 2: Previous discussions of LNAPL describe it as the main threat to groundwater quality in the Upper PRM Aquifer. However, the text in Paragraph 2 indicates that LNAPL exhibits little to no impact on groundwater concentrations of COPCs in the shallow, water table aquifer because of limited dissolution rates, ongoing natural attenuation, etc. Statements in the FS should be evaluated to provide a consistent message in regard to the relationship between LNAPL and groundwater quality.*

Response: The sentence in question should read "...samples collected from monitoring wells around the perimeter of the LNAPL areas confirm there is little to no impact of LNAPL..." rather than "...from monitoring wells installed in the LNAPL areas further confirm little to no impact of LNAPL...". The revision has been made in the text.

17. *Page 1-51, Section 1.5.1.3, Paragraph 5: The FS should provide concentrations at which the six COPCs exceeded the carcinogenic and noncarcinogenic risk thresholds.*

Response: The concentrations (Exposure Points Concentrations – EPCs) corresponding to the risk levels for the six COCs have been added to the FS Report text.

18. *Page 1-59, Section 1.6.1, Paragraph 4: The sentence states that "The New Jersey SWQSs (N.J.A.C. 7:9-6) are as stringent as or more stringent than the Federal MCLs..." N.J.A.C. 7:9-6 contains the New Jersey GWQC, not the SWQC. Furthermore, in addition to the above correction, paragraph 4 also states those standards are therefore applicable standards that are applied to analysis of ground water quality in the FS." However, in the case of BCEE and vinyl chloride (VC), the EPA Region 9 Tap Water PRGs for BCEE (0.0098 ug/L) and the Federal MCL for VC (2 ug/L) are lower than the GWQC.*

Response: SWQS has been revised to GWQS and the lower of the Federal MCLs/NJDEP GWQS for vinyl chloride noted; NJDEP GWQS = 2 ug/L. The Region 9 Tap Water number for BCEE is not applicable to BROS.

19. *Page 1-63, Section 1.6.5, Paragraphs 1 and 2: This section presents numerous points as to why the restoration of shallow groundwater would be difficult, if not impracticable. Points 1 and 3 specifically relate to the large volume of "source area" remaining in soil (i.e. the "large volume of continued release from the former lagoon, buried drums..." and the "larger volume of LNAPL distributed above and below the water table over*

approximately 20 acres"). While overall remediation of shallow groundwater may be impractical because of these and other issues, these continuing sources of shallow groundwater contamination are the main reason that a larger range of soil and LNAPL alternative should be evaluated in the FS. By including more aggressive remedial alternatives to actively treat or contain soil contamination and LNAPL, additional active groundwater treatment may not be required to meet PRGs in shallow groundwater. Overall, this section is in large part redundant with other sections, or simply professes improper arguments as to why the BROS site should not be held to normal cleanup standards.

Response: Based on the BROS Site conditions and in the presumptive remedy guidance for ground water (see Figure 1 of guidance), ground water restoration will be difficult. The discussion in Section 1.6.5 (Areas of Flexibility in Cleanup Approach) follows the USEPA guidance including the guidance on pumping and treatment decision-making and technical impracticability. The objective of this section is to provide relevant perspective on cleanup options and relevant flexibility considerations. Therefore, the analysis is appropriate and consistent with the BROS Consent Decree and the NCP. The revised FS Report presents remedial alternatives that aggressively reduce the mass loading to Shallow Ground Water (see response to general comment #4) and enhance ground water restoration in a manner that is protective to human health and the environment, consistent with the guidance applicable to the Site conditions remaining after the Phase 1 remedy. The Committee agrees that many of the flexibility factors are discussed elsewhere in the FS Report; however, they are presented together in an interrelated context, consistent with the guidance, to minimize the amount of discussion that is included in the alternative analysis sections.

20. Page 166, Section 1.7: This section simply restates the structure of the document, which has already been presented on Page 1-1. This section can be deleted.

Response: The relevant material from Section 1.7 has been added to Page 1-1 and Section 1.7 has been deleted.

21. Page 2-5, Section 2.1.1.1: All of the RAOs listed here are framed with regards to protection against exposure. Remediation is based on the goal of protecting both human health and the environment. It is not sufficient to eliminate pathways; efforts must also be made to restore the environment by cleaning up the contamination. The third objective should indicate the desire to eliminate groundwater impact from all contaminants, not just VOCs. Furthermore, the objectives are not based on risk criteria, but rather on MCLs or state criteria where they exist. This comment applies to other sections as well.

Response: As noted and detailed in Section 2.1 of the FS, the RAOs were prepared consistent with 1988 USEPA RI/FS guidance cited in the BROS Consent Decree. Each RAO is directed at protecting human health and the environment and specifies:

- the COC(s);

- exposure route(s) and receptor(s); and
- acceptable COC level or range of levels for each exposure route (i.e. a preliminary remediation goal).

The Committee has revised the third component to be more explicit whenever possible and practicable. However, the Committee recognizes that the guidance and the NCP (1990, p. 8713) emphasizes that protectiveness may be achieved by reducing exposure (such as capping an area, limiting access, or providing an alternate water supply) as well as by reducing COC levels. Related to ground water, the NCP notes that remediation levels can be set at or beyond the edge of the waste management area when waste is left in place (e.g. lagoon residuals and overlying incineration ash).

Taking into account these factors, the Committee recognized that it would be inappropriate to focus on COC levels in areas such as soils and Shallow Ground Water, where extensive remediation was already completed based on COC levels alone. These efforts resulted in a substantial reduction of COC mass but were not effective at reaching the excavation goals (see Figure 2-1). In addition, ground water removed from the former lagoon during Phase 1 work reduced the mass of COCs in ground water but several COCs remained elevated in Shallow Ground Water where LNAPL remains (Figures 3-16 and 3-17 of the Phase 2 RI Report). Nonetheless, a broad range of remedial technologies and sequenced applications of technologies were evaluated for LNAPL and Shallow Ground Water. More detailed evaluation of thermal treatment options was added to the revised FS Report. Consequently, the USEPA has several alternatives to choose from that are protective of human health and the environment through a combination of exposure controls and COC concentration reduction, to the extent practicable. The final cleanup goals are more appropriately set following the initial remedial actions taking into account the application of cost-effective technologies, relevant institutional controls and the implementability of additional remedial actions.

22. *Page 2-9, Section 2.1.1.3: The text argues that clean up of the shallow groundwater is both technically impractical and not necessary to protect human health and the environment. The former is true only if the NAPL which acts as a source cannot be eliminated, while the later is incorrect. The "site specific factors" invoked do not obviate the need to protect human health and the environment. Please amend.*

Response: Several remedial alternatives included in the analysis are capable of aggressively removing LNAPL from the area around the water table and restoring Shallow Ground Water over an extended timeframe. However, complete removal of LNAPL from below the water table and restoration of Shallow Ground Water is not practicable for reasons detailed in the text. In addition, the USEPA apparently misread the intent of the last sentence. It was not meant to imply that protection of human health and environment is unnecessary. To the contrary, the statement was intended to convey that complete restoration of Shallow Ground Water is not necessary to protect human health and the environment because of the lack of complete exposure pathways currently and existing institutional controls that prevent future exposure pathways. The text has been clarified accordingly.

23. *Page 2-9, Section 2.1.1.3, Paragraph 3: The Federal and New Jersey MCL for total dissolved solids (TDS) is 500 mg/L.*

Response: The reference was to 5,000 mg/L TDS standard for Class GW-III aquifers (not suitable for potable use). Text revisions have been made accordingly to recognize the 500 mg/L MCL.

24. *Page 2-9, Section 2.1.1.3, Paragraph 3: The FS should identify the monitoring wells in the lagoon area that exhibit elevated concentrations of TDS.*

Response: Agreed, the text was revised accordingly.

25. *Page 2-9, Section 2.1.1.3, Paragraph 4: Given the position of low permeability confining units between the Upper and Upper Middle PRM Aquifers and the location of surrounding surface water bodies, the statement that groundwater flow in the Upper PRM Aquifer is predominantly vertically downward is not entirely accurate. The text of the FS should be re-written to reflect a more realistic depiction of groundwater flow in the Upper PRM Aquifer.*

Response: The paragraph has been revised to clarify the vertical flow is primarily through gaps in the clay that occur beneath the BROS Property and they are illustrated on several plates and figures. Numerous hours have been spent analyzing and interpreting Shallow Ground Water flow utilizing the water table elevations, pumping test information and water budget data. Based on these efforts, the Committee feels the presentation of Shallow Ground Water flow on pages 2-9 and 2-10 of the December 2004 draft is reasonable and accurate to the degree possible at this time.

26. *Page 2-11, Section 2.1.1.3, Paragraph 1: A figure presenting the boundary of the Classification Exception Area (CEA) in the Upper PRM Aquifer should be provided to support the discussion in this section.*

Response: A figure has been added to the FS from the CEA/WRA report.

27. *Page 2-24 through Page 2-30, Section 2.3.1: To expand on prior General Comments, the remedial technologies for soil hot spots that were not retained for detailed evaluation include vertical barriers, horizontal barriers, stabilization, physical treatment, chemical treatment and biological treatment and thermal treatment technologies. Specifically, technologies such as cement-, silicate-, and sorptive-based reagents, soil-vapor extraction, dual-phase extraction, and removal were eliminated from inclusion in remedial alternatives. For example, removal was eliminated due to the difficulty of implementation and high costs. The elimination of all potential alternatives that include these technologies does not provide a full range of alternatives for these media.*

Response: See response to general comment #4 and the revised FS Report.

28. *Page 2-31 through Page 2-45, Section 2.3.2: As for soil hot spots discussed in Specific Comment #22, this section presents the technology screening for LNAPL. As with soil, many of the remedial alternatives for LNAPL were eliminated from inclusion in remedial alternatives, mainly due to implementation or cost considerations. The elimination of all potential alternatives that include these technologies does not provide a full range of alternatives for these media.*

Response: See response to general comment #4 and the revised FS Report.

29. *Page 2-41, Section 2.3.2: It does not seem accurate that steam (or other heating methods) would be ineffective in increasing the recovery of NAPL. They are certainly more expensive, but seem implementable and likely to be effective, especially in targeted areas.*

Response: Agreed, the statement was meant to relate to the residual LNAPL below the water table. The FS Report text has been revised.

30. *Page 2-46, Section 2.3.3: The statement that [EPA] removal actions have eliminated or siginificantly reduced primary and secondary sources to Shallow Ground Water at the BROS site is not a fair assessment. While EPA actions to date, including the extraction of over 9,000 gallons of contaminated LNAPL, have removed a significant amount of free phase oil, a significant amount of free phase product and residual material remains in the subsurface. This remaining material could have significant direct impacts to the shallow groundwater system at the site.*

Response: The Committee notes that USEPA actions to date extend far beyond the recent recovery of 9,000 gallons of LNAPL. A minor text change has been made accordingly.

The potential for movement of this material about the site is not completely understood. Therefore, EPA is not in agreement with the statement [Page 2-49] made by the Settling Defendants that horizontal movement of COPCs in shallow groundwater is not significant. In fact, it is significant that LNAPL is present off-property to the west of the former lagoon and is not being controlled at this time. Fluctuations in LNAPL thickness and movement throughout this area has been documented by EPA and its impact to the shallow groundwater is not clearly understood. This is an issue which should be addressed in the FS.

Response: The LNAPL issue is thoroughly addressed in the FS with the evaluation of several removal and control technologies, separately and in combination. Regarding LNAPL movements, Section 5.3.3 of the RI provides a detailed analysis of past and current movements of LNAPL. The conclusions included nearly all of the significant movement of LNAPL occurred when the lagoon contained oil (including the period of lagoon dewatering/excavation) and the movement since then has been primarily vertically with water fluctuations or a result of differential infiltration in areas of ponding and flooding of extraction trenches during storm events.

31. *Page 2-51, Section 2.3.2: Groundwater extraction is not carried forward based on the rationale that technological and administrative challenges would slow implementation. These are not reasonable criteria by which to completely eliminate an alternative. Both obstacles are surmountable.*

Response: Page 5-20 notes that both ground water extraction and phytoremediaton "are readily implementable." However, the comparative analysis evaluates a range of factors, including that TSCA prohibits undue spreading of PCB-oil in the environment, which is an unavoidable consequence of ground water extraction as a sole technology approach. Note that bioslurping and steam enhanced recovery includes the removal and treatment of substantial quantities of ground water (with minimal spreading of LNAPL) and are retained for detailed analysis.

32. *Page 2-73, Section 2.4.3.1.2: The description of this remedy refers to the 'alternative cover' as consisting of a vegetative cover of native species. Please provide some specifics as to what will make up the cover. Without this information, it is very difficult to judge how the cover might perform. Elements of the remedy such as the importation of soil and shallow groundwater monitoring are noted through the text; these should be spelled out in the description of what will be done. Also, the section generally overstates the effectiveness of evapotranspiration as a means of limiting infiltration, LNAPL mobility, etc. Plant up take of water has considerable temporal variation and it seems likely that at times a vegetative cover would provide some benefit, while other times providing almost none.*

Response: The proposed remedy for this alternative (Alternative SHS-2), Institutional Controls and Cover and Drainage Improvements, includes three primary components for reducing surface water infiltration through the former lagoon area: (1) regrading of the existing soil cover to promote positive drainage; (2) construction of an engineered storm water collection and conveyance system to limit storm water accumulation and infiltration; (3) and installation of an Alternative Final Cover (AFC) to promote evapotranspiration and further limit infiltration of storm water. As indicated in the FS Report, additional pre-design work will be required to determine the final top-of-cover elevations, the soil and vegetative types to be used for construction of the AFC, and the storm water collection and conveyance requirements. Soil types will be selected to ensure good soil tilth and optimize water storage capacity. It is projected that cool- and warm-season native grasses will be selected to increase the length of the growing season and optimize the viability of the vegetative cover and expected evapotranspiration rates. Poplars and willows will be incorporated into the cover during phytoremediation, if selected (see #33 response). While there will be temporal variations in evapotranspiration rates, the relevant technical literature and guidance (Brooks, et al., 1991) (Chapter 3 Evapotranspiration and Soil Water Storage; ITRC, 2003 and references therein (especially Section 1.2.5) and USEPA, 2003) provide substantial documentation that the proposed cover and drainage improvements will collectively offer substantial improvements relative to current conditions in reducing storm water infiltration and associated LNAPL mobility in the former lagoon area. The functioning of such a cover system over the course of a year is described in some detail in literature and takes into account the water budget of the entire year. The text and cost table for this alternative describe the projected import and placement of 44,000 cubic yards of select fill to achieve desired final elevations and soil cover thickness requirements and the ground-water sampling of ten shallow wells and three intermediate wells on a quarterly basis for five years and annually thereafter for effectiveness monitoring purposes.

33. *Page 2-80, Section 2.4.3.1.3: As with the previous section, the hydraulic effects of the alternative are overstated, in this case asserting that the trees would provide hydraulic control. It would likely provide some control of the most shallow groundwater during the summer months. It would be much less effective in the winter and in areas further below the water table. Note also that the argument is made that the majority of flow is downwards in this area and it is not clear that the trees would have a significant effect on the vertical gradient. Similarly, the positive effect on contaminant concentrations would be limited. With contaminated soil, groundwater and NAPL present to 40 feet, much of the area under consideration would be unaffected. This, of course, could be better evaluated with a clearer picture of how groundwater concentrations vary with the presence of residual NAPL. Furthermore, it does not seem clear that the trees could survive if planted in an area with LNAPL. The long term effectiveness of this remedy is therefore somewhat in questionable.*

Response: As noted in the response and literature cited to the previous comment, the hydraulic effects of a properly drained surface and the maintenance of vegetation to maximize evapotranspiration is well documented and has been accepted by the USEPA at other sites. The proposed remedy for this alternative (SHS-3) adds phytoremediation to the other remedy components described in the previous comment. The transpiration rates presented in the FS Report for densely planted hybrid poplars and willows are based on field experiences at similar sites as referenced in the Report. The predicted root depths of ten to 20 feet below ground surface and higher transpiration rates compared to typical grassy vegetative covers will optimize the degree of water uptake in the proposed planting areas. The effectiveness of the phytoremedation is predicted to be high as most of the residual COC mass is at or near the water table. Biodegradation of COCs and LNAPL significantly below the water table will not be enhanced by phytoremediation. However, the combined cover improvements will substantially reduce the mobility of the deeper COCs by reducing vertical flow rates. As described, the proposed phytoremediation component would be implemented in two phases. In the first phase, phytoremediation plantings would be made in areas where residual, but no free LNAPL is present. During the second phase, plantings would be implemented to address residual LNAPL after free LNAPL is removed by other proposed remedy components (e.g. bioslurping). In areas that overlap the proposed AFC, phytoremediation plantings would be used as part of the vegetative cover and would extend the evapotranspiration drying of the soil to the water table (capillary fringe), establishing a significant soil water deficit at the beginning of the non-growing (November to April in south New Jersey) season. Infiltration to the water table during the winter is minimized by soil retention (water storage capacity) of infiltrating water and runoff of precipitation by a properly drained surface, assisted at times by a frozen ground surface. The net result is that a small fraction of the precipitation infiltrates to the water table. In addition to minimizing water infiltration in these areas, phytoremediation will also promote the degradation of underlying waste and is documented to be effective with the types of wastes remaining in the subsurface at BROS. As indicated in the FS Report, additional pre-design work will be required, possibly including limited field plot trials, to finalize plant selection, planting densities and nutrient requirements, and evaluate Site-specific COC impacts on plant health and yields. However, the adverse effects on the trees is predicted to be minimal if product and VOC recovery actions are completed prior to tree planting and taking into account there is typically five feet of unimpacted soil overlying the area with residual LNAPL.

Both the AFC and phytoremediation remedy components (Plate 8) are designed to work with existing conditions following completion of the Phase 1 ROD at the Site to reduce surface water infiltration and reduce COC mobility, toxicity and volume in the former lagoon area. While viable technologies in their own rights for addressing residual COCs in shallow soil and ground water at the Site, they are proposed for use in conjunction with other remedy components collectively designed to address impacted shallow soil, Shallow Ground Water and LNAPL media present at the Site. These remedy components include the in situ enhanced biodegradation of COCs in shallow soil; bioslurping to physically remove and promote the degradation of LNAPL, Shallow Ground Water, and volatile COCs (Plate 8); and institutional and engineering controls to manage and control potential exposure pathways. In addition, effectiveness monitoring and contingent remedial actions are proposed for all remedy components to address the possibility that proposed remedy components do not achieve performance expectations.

34. *Page 2-85, Section 2.4.3.1.4: SHS-4 - This alternative includes the addition of materials to the subsurface in order to promote aerobic or anaerobic degradation. These approaches are more suitable to treat contaminants dissolved in groundwater and rather than a soil remedy alternative.*

Response: The Soil Hot Spots are defined based largely on soil data, although ground water concentrations are known to be high in Soil Hot Spots. As the enhancements are meant to stimulate microbial populations that are largely attached to the soil matrix and address COCs that originate from soils and LNAPL in Soil Hot Spots, the technology will be retained in this alternative but recognized in relation to ground water in the combined alternative analysis.

35. *Page 2-101, Section 2.4.3.2.2: The potential layout and application of a barrier in the Gaventa pond are is unclear. Presumably, this would be some sort of liner installed underwater in the lake, but a better description needs to be included. It should also be more clearly stated why this would be the preferred approach rather than a vertical barrier on land - such as sheet piling.*

Response: The Committee feels a more detailed analysis of alternatives is not warranted as the 1984 ROD simply stated the seep area would be excavated as part of the Phase 1 remedy. A liner provision was added by the Committee to ensure a barrier exists between the clean surface sediment and the residual COCs that remain in the bank of the pond. The specifics of the construction would be proposed as part of the remedial design.

36. *Page 2-110, Section 2.4.3.2.4: It is not clear how the 3.6 months per year time-frame for bioslurping was selected. If this is somehow considered optimal, the document should explain why this is the case. If free LNAPL is present and can be removed at other times, then this would in fact, not be optimal.*

Response: Following review of the USEPA comments and discussions with the USEPA in June 2005, the Committee revised the bioslurping proposal to include recovery year round, two months of operation followed by one month for system recovery/rebound. The text and costing have been adjusted accordingly.

37. *Page 2-126, Section 2.4.3.3.2: In discussing compliance with ARARs, it should be acknowledged that groundwater ARARs such as MCL would apply to a natural attenuation remedy. MNA would not be selected for a site unless it is shown to be as effective at meeting ARARs as other options.*

Response: Agreed.

38. *Page 2-131, Section 2.5: It is not clear why the text suggests that LNAPL might be mobilized by injection of electron donors or acceptors. The does not seems correct.*

Response: The statement in the text referred to potential limited LNAPL movement that could occur if a significant volume of nutrient solution were introduced over a short period causing ground water mounding. A minor text clarification has been made.

39. *Page 3-1, Section 3.0: As stated in comments on the RI, it has not been established that contaminants fully attenuate by the time they reach the deep groundwater zone. The statement here goes as far as stating that the groundwater reaches NJ GWQS levels; there is no well data showing this is the case and the statements should be deleted.*

Response: The FS Report text has been revised consistent with revisions made to the RI Report.

40. *Page 3-5, Section 3.1.1.1, Paragraph 3. This section bullets a list of COPCs in deep groundwater in the PTZ. However, this is not a comprehensive list of COCs to be addressed in the PTZ in deep groundwater. More detail is required as to the SVOCs (stated as "primarily BCEE") and metals (stated as "primarily iron and manganese") that are the COCs in deep groundwater.*

Response: The COCs in Deep Ground Water are detailed in the RI Report and taken into account in the FS Report. For example, the ground water treatment evaluation takes into account all the COCs. Section 3.1.1.1 is intended to provide a brief summary of the primary COCs. Consequently, no revisions were made to this section.

41. *Page 3-5, Section 3.1.1.1., Paragraph 4. The FS should mention public water supplies in the area, although reasonable distances from the BROS site, originate from the Middle PRM Aquifer.*

Response: Agreed, a revision has been made accordingly.

42. *Page 3-6, Section 3.1.1.1: Restoration of the aquifer is the meaningful RAO here. The 'Option B' is not in line with accepted approaches and will not be considered.*

Response: Option B is consistent with the NCP and USEPA guidance on ground water management cited throughout the FS Report. The NCP notes (p. 8732) that in cases such as BROS where "there are other readily available drinking water sources of sufficient quality and yield that may be used as an alternative water supply, the necessity for rapid restoration of the contaminated ground water may be reduced." Option B recognizes this consideration if the analysis finds more rapid restoration would be less cost-effective or impracticable.

43. *Page 3-8, Section 3.2, Bullet 3. MNA is listed as a viable general response action for the PTZ in deep groundwater. However, this response action is not included in Table 3-1, as referenced in this section. In Table 3-1 (and subsequent tables with technology and process options) MNA is listed under an in-situ response action.*

Response: The FS Report text has been revised accordingly.

44. *Page 3-10, Section 3.3.2, Paragraphs 3 and 4. This section discusses the initial screening step of remedial technologies for both the PTZ and areas downgradient of the PTZ in deep groundwater. Section 3.3.2.1 includes the technology evaluation for the PTZ and 3.3.2.2 includes the evaluation for the area downgradient of the PTZ. However, in Section 3.3.2, prior to Section 3.3.2.1 there is a discussion of the No Further Action/Institutional Controls technologies that seems to be out of place. It should be made clear that these technologies were discussed separately since they are consistent with both the PTZ and downgradient of the PTZ areas.*

Response: Agreed, the FS Report text has been revised.

45. *Page 3-11, Section 3.3.2: The text states that there are different RAOs for the downgradient portion of groundwater compared to the on-site, PTZ groundwater. The RAO is restoration for both areas; it is not different in areas where concentrations are lower, as is argued in the text.*

Response: To the extent that the RAO incorporates the PRGs as a chemical specific component of the RAO, the PTZ and Downgradient Areas are different because many of the COCs detected in the PTZ do not occur in the downgradient areas.

46. *Page 3-13, Section 3.3.2.1, Paragraph 3. The most contaminated portion of the*

plume in the Upper Middle PRM Aquifer is a contiguous body that extends from beneath the lagoon and several hundred feet to the southeast. The FS should not attempt to separate the most contaminated portion of the plume into segments that reside on the side and immediately downgradient, north of Swindell Pond.

Response: As discussed on numerous occasions with the USEPA, the physical and chemical water quality data from the north side of Swindell Pond (PTZ and LTZ) is distinctly different from water quality in the area downgradient of Swindell Pond as illustrated on numerous figures and plates and discussed in the RI/FS documents. Recognizing the distinction is reasonable and necessary as many of the remedial alternatives are readily applicable to one area but not to the other, consistent with USEPA guidance.

47. *Page 3-14, Section 3.3.2.1, Bullet 3. The word "combinations" is spelled incorrectly.*

Response: Agreed, the FS Report text has been revised.

48. *Page 3-15, Section 3.3.2.1: As the authors are well aware, reclassification of the aquifer as non-potable is not an option. Groundwater is not reclassified as a result of contamination. This needs to be removed from the report.*

Response: Although it has not been done to date, the New Jersey ground water rules provide for aquifer reclassification where regional water quality problems from multiple sources are predicted to remain for extended periods of time. Aquifer reclassification has been retained in the section but eliminated from further consideration based on implementability.

49. *Page 3-16, Section 3.3.2.1, Paragraph 2, Sentence 1. Typographical error: selected.*

Response: Corrected in FS Report text.

50. *Page 3-16, Section 3.3.2.1, Paragraph 3. Typographical error: Air Spacing/Soil Vapor Extraction should be Air Sparging/Soil Vapor Extraction.*

Response: Corrected in FS Report text.

51. *Page 3-25, Section 3.3.3, Paragraph 4. This paragraph references Table 2-4, which is not the correct reference. This should be changed to Table 3-4.*

Response: Agreed, a revision has been made to the FS Report text.

52. *Page 3-30, Section 3.3.3.3, Paragraph 2. This section states that only two technologies (chemical oxidation and monitored natural attenuation) were retained for inclusion in remedial alternatives. On Table 3-4, neutralization is also listed as a retained technology option. This should be clarified.*

Response: Neutralization is included as a component to a Biological Treatment bullet that has been added.

53. *Page 3-30, Section 3.3.3.3, Paragraph 3. In this section, there are two technology groups for in-situ treatment retained for deep groundwater. On Table 3-4, alternative residential water supply is listed as a technology option, with a note that this option was implemented during the Phase I or Phase 2 RI. This note should also be added to the in-situ technology discussion of Page 3-30.*

Response: Agreed, the FS Report text has been revised.

54. *Page 3-30, Section 3.3.3.3, Paragraph 3. This paragraph states that "Three ground water ex-situ treatment remedial technologies (physical, chemical, and biological treatment) and four discharge process options (constructed wetlands, surface water, ground water reinjection and off-Site disposal) were retained in the secondary evaluation process (Table 3-4). However, this sentence is inconsistent with the information provided in Table 3-4.*

Response: Table 3-4 has been revised to be consistent with the FS Report text.

55. *Page 3-31, Section 3.3.3.3, Paragraph 1. This section states that chemical precipitation with pH adjustment will be the primary mechanism for removal of metals in groundwater after extraction. This is a viable technology for removal of these compounds. However, due to the high manganese content in groundwater, another viable treatment process that should be considered in greensand filter. These systems are highly effective in removing metals in groundwater.*

Response: Alternative technologies to address metals removal will be evaluated as part of pilot studies to confirm the optimal treatment train for ground water.

56. *Page 3-31, Section 3.3.3.3: The text states that high levels of contaminants such as ketones and ethers preclude the effective use of technologies such as air stripping. The RI does not present any information about high levels of ketones. A more complete understanding of the occurrence of these contaminants is needed.*

Response: Table 3-8 presents a detailed analysis of all COCs in monitoring wells 23D, 36D and S-11C in relation to discharge to ground water and discharge to surface water criteria including the ketones and ethers. A reference to Table 3-8 has been added to the subject paragraph.

57. *Page 3-34, Section 3.3.3.4, Paragraph 2, Bullet 1. States that the technology process options are included in Table 3-4b. There is no Table 3-4b, rather these are presented in the latter portion of Table 3-4.*

Response: The FS Report text has been revised accordingly.

58. *Page 3-35, Section 3.3.3.4: EPA disagreed with the conclusions drawn from the treatability tests. Aerobic biological treatment may have some positive effect on the BTEX compounds, but will not clearly address BCEE - and it will create an environment that is less conducive to degradation of CVOCs. Subsequently, it seems unlikely that this element alone would be sufficiently effective.*

Response: The treatability study did show BCEE degraded under aerobic conditions. The mechanisms for the degradation are discussed in Section 5.4 of the RI Report, which has been revised to include more detail and inclusion of relatively recent supportive literature.

59. *Page 3-37, Section 3.4.1: The text states that long term pumping or high withdrawal rates could redistribute COPCs in the shallow groundwater (including LNAPL and PCBs) and adversely affect the functionality of the wetlands. Yet, significant proofs of this statement are not provided. While pumping at very high rates for a long period could somewhat depress the water table, it is unlikely that the LNAPL or PCBs would be significantly redistributed - especially as residual NAPL is already present to 40 feet bgs. Also, it would take very high rates of pumping to depress the water table to the extent that wetlands are damaged. There is already considerable fluctuation in the water table and the drawdown would not likely be great enough to have a serious impact. It also bears mention that most of these issues have even less merit with long term pumping at the rates that would likely be instituted. Furthermore, in conjunction with LNAPL removal, depressed water levels could have a positive effect.*

Response: There is substantial proof that pumping and water table drawdown redistributes LNAPL. For example, the Lagoon Work and shallow ground water aquifer test both lead to movement of LNAPL into strata where it previously did not exist. In addition, the comment reference to residual NAPL down to 40 feet bgs is misleading. Some areas below the 30 acre property are known to contain residual LNAPL down to 40 feet. However, there is a large portion of the property where PCB-LNAPL could be spread to strata where it currently does not exist if depression of the water table by pumping were to occur, especially during low precipitation periods. Also, the potential for redistribution of COCs in Shallow Ground Water and impacts to wetlands is only one of eight site-specific factors noted as considerations taken into account during the alternative development and evaluation process.

60. *Page 3-38, Section 3.4.1, Bullet 2. The sentence stating there is an "abundant sources of unimpacted groundwater south of I-295" within the CEA/WRA extent. If the current extent of the CEA/WRA documents the extent (and any potential migration) of the COCs seen from the site, then there is no unimpacted groundwater within the current CEA/WRA extent.*

Response: As noted in places throughout the RI Report, the CEA/WRA approved by the NJDEP is limited to the bottom 15 feet of the Upper Middle PRM south of I-295. Consequently, the entire Upper PRM (average thickness 80 feet south of I-295) is available for water supply and the upper portion of the Upper Middle PRM is also available for supply or to serve as a buffer between the Upper PRM and the CEA/WRA portion of the Upper Middle PRM. A continuous clay confining unit separates the Upper PRM from the Upper Middle PRM throughout the areas south of I-295.

61. *Page 3-38, Section 3.4.1, Paragraph 2. Soil sampling of the aquifer test programs for the Water Table/Upper PRM Aquifer, and Upper Middle PRM Aquifer should each contain a figure providing observation well locations and a table describing observation well construction. This type of information should be provided in the report, rather referencing Appendix L and M.*

Response: As noted in the RI Report, the aquifer test yielded information that confirmed the Upper PRM and Upper Middle PRM at the BROS Site are substantially similar hydrogeologically to the Chemical Leaman site and elsewhere as described by the USGS. Consequently, more detailed presentation of the aquifer tests in the test is not needed to support the alternative analysis.

62. *Page 3-38, Section 3.4.1: The removal of contaminated groundwater from a Critical Aquifer Area does not run contrary the desire to limit withdrawals. Also, the existence of a CEA/WRA and the presence of clean water from other sources have no bearing on the selection of alternatives. These bullets should also be eliminated. Note that these arguments are made again in the bullet on the top of page 3-40, where they also should be dropped.*

Response: ELM has discussed the influence of the Critical Aquifer Area on the alternative analysis with NJDEP water supply personnel on several occasions. They indicated that non-pumping or minimized pumping would be preferred if other alternatives could be protective. In addition, several township representatives, including former Mayor Wright, voiced concern over the impacts of alternatives that would withdraw ground water over extended periods of time. Regarding the consideration of the CEA/WRA and other sources of clean water, the NCP (Page 8732) and USEPA guidance cited in the FS Report recognizes that the determination of reasonable restoration times should consider if there are other readily available drinking water sources. If they are available, the necessity for rapid restoration may be reduced. The availability of institutional controls such as the CEA/WRA can also be taken into account when considering the effectiveness of less aggressive restoration alternatives. Consequently, no revisions have been made in response to this comment.

63. *Page 3-39, Section 3.4.1: The third bullet argues that containment will have limited benefits. If the RAO is restoration, a stable plume and no groundwater users have no bearing on the benefits of containment. Containment would prevent contaminants from leaving the site and have a very positive effect in restoring downgradient groundwater. This is further supported by the modeling figures in this section which show downgradient contaminant levels persisting for a long time, even with portions of the source removed.*

Response: Containment is not a permanent solution and does utilize treatment to remedy the principal threat area as is strongly preferred under the NCP. However, if implemented, then increased downgradient reduction of the distribution of COCs would occur under an area where potable use does not and will not occur (i.e. Little Timber Creek Swamp, I-295 and its ROW, and Swindell Pond). In other words, containment would not expand the use of ground water near the BROS Site.

64. *Page 3-40, Section 3.4.1: The text states that MNA is eliminated from further consideration. Presumably, this is intended to refer only to the area under the site, not downgradient. MNA is included in options for the downgradient areas. Please clarify.*

Response: The text has been clarified to indicate that MNA was screened out as a sole technology in an alternative for all of Deep Ground Water.

65. *Page 3-42, Section 3.4.1: The numerical, second tier analysis is very subjective and makes the assumption that all factors should always be weighed equally. In fact, the comparison is typically set up more qualitatively for the very reason that judgement must come into play. The second tier screening is therefore of limited value. Furthermore, the only thing ruled out by 'tier 1' screening is MNA for the entire deep groundwater. This could and should be ruled out in the technology screening, making it so that there is no benefit from artificially breaking the screening into two tiers.*

Response: A two-tier screening is commonly completed as part of the CERCLA FS process. The semi-quantitative second tier analysis is tempered with professional judgment and consideration of site-specific factors. ARARs and protectiveness are given more weight in the analysis (threshold factors) and therefore are evaluated as a tier one analysis. MNA is applicable to the Site in combination with other technologies and it would therefore be inappropriate to eliminate it entirely in the technology screen.

66. *Page 3-44, Section 3.4.2.1: Discussion of the No Action Alternative includes the assumption that LNAPL in the shallow zone will continue to be removed. Actions in the shallow zone have not been determined and should not be assumed to be part of the No Action Alternative in the deep zone.*

Response: The assumption of free LNAPL removal is consistent with the 1984 ROD and the USEPA's ongoing actions and therefore retained as a reasonable assumption.

67. *Page 3-46, Sections 3.4.2.2 and 3.4.2.3: In screening Alternatives 2A and 2B it is predicted that pumping for restoration would have to continue until NA reduces concentrations. While clean up would be slowed by diffusion processes, pumping would speed clean up relative to NA - for several reasons. In addition to the mass removal achieved, the pumping would maintain lower concentrations in the conductive horizons, which would increase concentration gradients and thus speed the back diffusion out of the lower conductive units. It would also serve to flush the highly acidic horizon, gradually raising pH - which would also have a positive effect in terms of enhancing the potential for biological degradation.*

Response: As noted in several places in the FS Report, restoration pumping and treatment would not be cost-effective at BROS, consistent with USEPA guidance, technical literature and the Site-specific conditions at BROS. The alternative analysis indicates pumping and treatment would be effective in reducing mass and improving conditions for biological degradation. Therefore, pumping and treatment is retained for those applications.

68. *Page 3-47, Section 3.4.2.2, Paragraph 1. Similar to previous comments, COPCs identified for the BROS site (TCE, benzene, dichloroethene, vinyl chloride, PCBs, and BCEE) have not been identified in subsurface soil samples collected from the confining bed at the base of the Upper Middle PRM Aquifer, or in sand/gravel samples in the aquifer. Subsequently, statements on the role of diffusion in controlling COPC concentrations during extraction alternatives are based on conjecture.*

Response: There were a limited number of soil samples collected from the top of the confining layer to determine if DNAPL might be present, indicated by highly elevated concentrations. The sampling design and analytical methods were not developed to determine the range of concentrations in soil pore water or adsorbed to soil in the confining layers in the Upper Middle PRM. The Committee relied on technical analysis of the Site conditions in relation to USEPA guidance and technical literature to determine that a substantial mass of COCs is distributed in the low permeability strata.

69. *Page 3-50, Section 3.4.2.3, Paragraph 1. The Draft FS provides no supporting calculations or modeling output to support the number of extraction wells, or pumping rates for Deep Groundwater Alternative 2B.*

Response: Attachment 2 (former Attachment 1 in draft FS Report) contains the basis for, and details regarding a preliminary design of a ground water extraction system to support development of a remedial alternatives evaluation for the removal of one pore volume of ground water from the Principal Threat Zone (PTZ) using optimized extraction rates for individual wells and minimizing extraction of ground water from outside the zone. The number of wells or pumping rates for Alternative 2B were estimated using the results of the analysis included in Attachment 2.

70. *Page 3-52, Section 3.4.2.3, Paragraph 1. Based on previous statements regarding the lack of supporting data on diffusion controlled transport during the course of extraction alternatives, scoring for the alternatives appears biased to the low side.*

Response: See response to specific comment #68 and Section 3.0, paragraph 2.

71. *Pages 3-54, 3-61, and 3-68, Section 3.4.2.4: Alternatives 3A, 4B, and 5B - For all of these alternatives, it is unclear as to the exact locations and mechanisms for delivery of oxygen source in downgradient groundwater. As written in Alternative 4B, it seems that the injection system will be installed immediately*

downgradient of the PTZ. It is then presumed that natural groundwater flow will distribute the oxygen source along the downgradient portion of the plume. There has been no discussion on how to ensure that a proper oxygen content will be delivered to the entire downgradient portion of the plume. If the results of the testing demonstrate that COC reduction is primarily surrounding the injection point, then a series of injection wells along the length of the downgradient plume may be required. If limited degradation is seen downgradient, then these alternatives may not be as effective long-term, and may need to be reconsidered.

Response: In alternatives 3A and 5B, the hydrogen peroxide ISCO treatment of the PTZ will be sufficient to stimulate the current aerobic biodegradation processes in the downgradient area by increasing D.O. and reducing or eliminating the biological oxygen demand of ground water flowing into those areas from the PTZ. The distribution system would utilize the PTZ injection wells along the south side (Attachment 2). In alternative 4B, which does not include ISCO, enhancement of existing aerobic biodegradation processes in the downgradient would occur by installing a series of approximately 200 injection wells (probably along the I-295 ROW) into the base of the Upper Middle PRM (number of wells increased and location changed in revised FS). Under both scenarios, the enhanced biodegradation conditions would be transmitted with ground water flow until the entire area with COC residuals is positively affected. A more aggressive distribution system for enhancements is not warranted because: (1) the distribution of COCs is stable (in equilibrium with current sources) and will decrease if source reduction or control actions are taken; and (2) reliable alternate water supplies are available during restoration.

72. *Page 3-55, Section 3.4.2.4: The text argues that the application of ISCO would represent advantages over pumping in that it is not limited by diffusion from the low conductivity units. This may not be true. Fenton's reactions would occur very quickly and would likely not penetrate significantly into clays. The result could be somewhat similar to pumping in that the contaminants in the sandy units would addressed, but diffusion from the clays would then cause significant rebound. This comment is also relevant to the Alternative 5 options.*

Response: The comment is accurate in that both pumping and treatment and ISCO have diffusion limited aspects. A primary point in the alternative analysis is that a strong inward gradient of oxidizer into silt and clay strata can be achieved at several points in a duplicative application of ISCO. Given that most of the mass of COCs will be distributed closer to the interface of permeable and less permeable strata, any penetration of the high concentration of ISCO agent into the silt or clay strata would destroy substantial COC mass that would otherwise diffuse out slowly, especially after the initial decrease in concentrations.

73. *Page 3-56, Section 3.4.2.5: The description given here indicates that NA would be relied upon for the downgradient portion of the plume. In other alternatives, this is included as a remedy element - and to properly compare different approaches, it seems that it should also be included here.*

Response: Natural attenuation is specifically considered in the Tier 2 evaluation of Alternative 3B.

74. *Page 3-56, Section 3.4.2.5: Neutralization of acidic conditions is included in this alternative, but is not mentioned in the description of Alternative 3A. Based on the costing tables for the two alternatives, it is included in both; please clarify this in the text.*

Response: The description of Alternative 3A on Page 3-54 of the draft FS Report includes the pH adjustment element.

75. *Page 3-57, Section 3.4.2.5: It is not clear that Alternative 3A is truly harder to implement than 3B. While more work would have to be done, there are no aspects of the more aggressive approach that present problems in actually instituting the injections.*

Response: Both 3A and 3B rate relatively high in implementability. Given that there is an extended period of treatment in 3A and the possibility that some of the ISCO injection wells might have to be replaced, 3B was rated one point (out of ten) higher that 3A.

76. *Page 3-57, Section 3.4.2.5, Paragraph 3 and Table 3-7. Alternative 3B was initially ranked during the Tier 2 evaluation to determine if it should be included in the detailed evaluation of groundwater alternatives. In Table 3-7, Alternative 3B was ranked at 35 points out of 50, which is the same ranking given to Alternative 3A. Considering that Alternative 3A also includes active treatment of the downgradient portion of the deep groundwater plume, there is a case that this alternative should be ranked higher than Alternative 3B. Treatability testing has demonstrated that enhanced aerobic biodegradation will reduce concentrations of COCs (specifically BCEE, which has the highest risk). Therefore, there is a case that Alternative 3A should be ranked higher than Alternative 3B.*

Response: The tradeoffs between the two are clearly evident in the analysis and are based on reasonable site-specific factors. Because ISCO treatment of the PTZ and enhanced biodegradation are both retained as alternatives included in the detailed analysis, no scoring adjustments are warranted.

77. *Page 3-58, Section 3.4.2.6, Paragraph 1. No supporting calculations or groundwater flow modeling is referenced for determining the number of extraction wells, or pumping rates for Alternative 4A.*

Response: There is more detailed discussion of the tradeoffs of pumping scenarios in Attachment 2. A reference to that attachment has been added to Section 3.4.2.6.

78. *Page 3-59, Section 3.4.2.6, Paragraph 1. The BROS site is located outside the boundary of Critical Area No. 2, thus concerns for requesting allocation for extraction systems are not valid.*

Response: The NJDEP set the Critical Aquifer Area No. 2 in 1994 and has openly recognized that it should be updated and expanded to include all of the area where ground water flow is away from the Delaware River, the opposite direction of natural flow due to regional overpumping. Therefore, consideration of the Critical Aquifer Area in the alternative analysis is appropriate.

79. *Page 3-60, Section 3.4.2.6, Paragraph 2. States that "NJDEO and FHA would not..." This should read "NJDEP and FHA..."*

Response: Agreed.

80. *Page 3-61, Section 3.4.2.7: The description of enhanced biodegradation is more extensive here than for Alternative 3A. Please give a full description of remedy elements the first time they are presented. Then in antecedent alternatives, the previous one can be referenced with any differences noted.*

Response: The description of enhanced biodegradation 4B is different and slightly longer that 3A because 4B requires the installation of new injection wells along I-295 while 3A would utilize the injection wells from ISCO in the PTZ.

81. *Page 3-62, Section 3.4.2.7: A number of the conclusions if the tier 2 evaluation are weak. Diffusion would limit the effectiveness of enhanced biodegradation in a similar fashion to the pump and treat. Pumping would also be at least as effective at reducing toxicity and volume, perhaps even more effective. It would also be likely to reduce the mobility of contaminants to a greater extent than the enhanced biodegradation. This comment applies to other sections as well, where similar statements are made.*

Response: The FS Report text has been clarified to indicate that the long-term "cost-effectiveness" of in-situ treatment methods is greater due to diffusion limitations which lead to unnecessary treatment of a large volume of unimpacted ground waters. Cost-effectiveness includes concurrent consideration of effectiveness, implementability and costs.

82. *Page 3-64, Section 3.4.2.9: Alternative 5 - There are several assumptions for this alternative which are overly optimistic. For instance, the text argues that removal of a single pore volume of groundwater will result in the identification of rebound hot spot areas. Removing one pore volume will most likely leave the entire area still contaminated, with diffusion rebound from all types of units - sands and clays. This approach will not limit the physical extent of where ISCO would be needed. The main benefit is that it would slightly decrease the concentrations of peroxide that would need to be applied. A related issue argument that removal of one pore volume will increase the mass reduction that ISCO could achieve at the interface between high and low permeability strata. Again, it may be that slightly lower concentration of peroxide could be used. However, given the short activity span of peroxide, the amount of diffusion into*

low conductivity layers is going to be very small. The advantage gained by the initial pore volume is not likely to be the limiting factor.

Response: The Committee agrees that removal of one pore volume alone will likely leave the entire PTZ exceeding PRGs. However, the relative amount of rebound will aid in the fine tuning of the design and application of the oxidizing agent, especially following the subsequent pore volume removals with the second ISCO application. The

benefits of ground water removal are detailed in the bullets on Pages 3-65 and 3-66 of the draft FS Report.

83. *Page 3-64, Section 3.4.2.8, Paragraph 2 and Table 3-7. Alternative 4C is ranked higher than Alternative 4B (28 and 27 points, respectively). However, Alternative 4B includes active treatment of the downgradient portion of the plume, rather than MNA as proposed in Alternative 4C. We believe that the reduction of volume of the contaminant mass in downgradient groundwater presents a case to rank Alternative 4B higher than 4C. While we recognize that there are implementation issues surrounding Alternative 4B, these should not cause Alternative 4B to have an overall rank higher than Alternative 4C.*

Response: After achieving the threshold criteria of protectiveness and ARARs, no one factor gets weighted preferentially. Alternatives 4B and 4C will ultimately achieve the same restoration goals, just in different timeframes. However, the Committee did note that the short term effectiveness of 4B should rank higher than 4C, yielding equal total scores of 28 based on other tradeoffs.

84. *Page 3-65, Section 3.4.2.9, Bullet 2. Typographical error. "ther" should be "the".*

Response: Agreed.

85. *Page 3-72, Section 3.4.2.1.3, Paragraph 2. Subsurface soil samples collected in the confining layer at the base of Upper Middle PRM, overlying discontinuous clay lenses, or aquifer sands contained no concentrations of COPCs above MDLs, particularly in downgradient portions of the plume. Subsequently, eliminating alternatives for desorption or diffusion-controlled transport is highly presumptive, and should be reconsidered.*

Response: See response to general comment #15.

86. *Page 3-73, Section 3.4.2.1.3, Paragraph 2. The draft FS should reference where, and the type of analysis used to estimate degradation rates for TCE. Attenuation rates and their derivation are important for evaluating the validity of the natural attenuation analysis combined with TCE reduction at the source area.*

Response: A reference to Section 5.4 of the RI Report has been added to the paragraph. In addition, discussion of the attenuations rates is provided on Pages 3-73 and 3-74 of the draft FS Report.

87. *Page 3-84, Section 3.5.3.2, Paragraph 1. Similar to discussion in previous comments, no calculations, or output groundwater flow modeling simulations are provided to support the number of injection wells, or injection rates required to treat the PTZ in Alternative DGW-2.*

Response: Paragraph 1 on Page 3-84 references Attachment 1 of the draft FS Report (Attachment 2 of the revised draft FS Report) for the supporting calculations. See the response to general comment #18 regarding the use of modeling.

88. *Page 3-85, Section 3.5.3.2: The text notes that PVC wells will be used for injection of peroxide. Given both the corrosive nature of the oxidant and the heat and pressure generated during injection, it seems unlikely that PVC would be an appropriate well material. Neutralization of the aquifer with sodium hydroxide would also be an exothermic process and likely to damage the wells. This will substantially impact the cost of ISCO alternatives and more concrete justification of material compatibility needs to be provided.*

Response: The BROS Technical Committee recognizes the USEPA's concerns regarding the heat and pressure generated by the ISCO and neutralization exothermic reactions and the corrosive nature of the oxidant. The use of PVC wells, however, should be sufficient for these applications for the following reasons:

- Based on the COC concentrations present in deep ground water and the amount of chemical oxidant and neutralizing agent needed to address these COCs, it is not predicted that the energy generated by the ISCO reactions will be sufficient to increase temperatures to a level that would compromise the well integrity. In addition, the rates of addition can be governed to maintain temperature control and prevent excursions that might be compromising the wells;
- The ISCO treatment and neutralization periods are temporary (approximately two years), and the wells would be abandoned upon completion of these remedy components. The need for stainless steel or other material with a potentially longer life expectancy is greatly reduced because of the short timeframe that these wells will be used; and
- Material compatibility tests can be completed during the pre-design, pilot study and remedial design phases to confirm the above conclusion. A final decision on well materials can be made during the design phase. Contingency costs included in the remedial alternative cost estimates are sufficient to allow for an upgrade in materials of construction for select wells if necessary.

89. *Page 3-86, Section 3.5.3.2: The text suggests that ISCO injection would occur over roughly 6 months. This is largely a design issue, but 3 injections in 6 months will not allow much time between injection for monitoring rebound.*

Response: Agreed, the Committee revised the conceptual design to three injections over one year to include more time for monitoring between applications.

90. *Page 3-89, Section 3.5.3.2: The text references Attachment 1 in discussion a 30 well pilot phase for ISCO. This is not discussed in the Attachment.*

Response: The text refers to Attachment 1 in relation to the conceptual design. The pilot study would be scaled at about 10% of the full design. The FS Report text has been clarified as to this point.

91. *Page 3-93, Section 3.5.3.2, Paragraph 2. The post-treatment monitoring period should be based on empirical data such as groundwater flow rates, biodegradation rates, etc. An arbitrary value of 180 days for post treatment monitoring seems excessively short to properly evaluate contaminant rebound, or flow of displaced, contaminated groundwater back into the treatment zone.*

Response: The conceptual design has been revised to include one year for ISCO application and one year for post-ISCO monitoring.

92. *Page 3-97, Section 3.5.3.3, Paragraph 2. This paragraph states that DGW-3 is similar in protectiveness of human health and the environment. However, Alternative DGW-3 is not equivalent to protection of human health and the environment since this alternative does not include active treatment of the downgradient portion of the plume. This is a consistent message throughout the evaluation of the remedial alternatives. Generally, alternatives that include active treatment are more protective of human health and the environment than alternatives that rely on MNA.*

Response: The degree of protectiveness depends on the need for the resource and the potential for exposure. At the BROS Site, alternate water supplies are predicted to be readily available throughout the planning horizon. Therefore, the timetable for restoration does not significantly influence the protectiveness comparison of alternatives. See response to specific comment #42.

93. *Page 3-99. Section 3.5.3.4, As described in the General Comments, a figure is required for Alternative DGW-4 to illustrate the location of containment wells in the PTZ, and injection wells in the downgradient areas.*

Response: Figure 3-9 has been added to illustrate the location of the containment wells and injection wells in the downgradient area.

94. *Page 3-100, Section 3.5.3.4, Paragraph 1. Similar to discussion in previous comments, no calculations, or output groundwater flow modeling simulations are*

provided to support the number of containment wells, in Alternative DGW-4.

Response: From a preliminary design standpoint, the calculation of the number of wells and the volume of pumping to contain the PTZ and LTZ areas is fairly straight forward. The design of the ground water recovery system is based on a straightforward analysis of the aquifer characteristics and the size of the PTZ and LTZ, as determined in the RI. The PTZ has a cross-gradient area of approximately 45,000 ft^2 (1,500 ft H by 30 ft V). With a hydraulic conductivity of 77 ft day^{-1} and a hydraulic gradient of 0.001, the groundwater discharge through the zone is:

$$
\begin{aligned}
Q = kiA, \quad &= 77 \text{ft day}^{-1} (0.001)\ 45{,}000 \text{ ft}^2 \\
&= 3{,}500 \text{ ft}^3 \text{ day}^{-1} \\
&= 26{,}250 \text{ gpd} \\
&= 18 \text{ gpm}
\end{aligned}
$$

The hydraulic analysis was based on recovery of ground water for the entire saturated thickness of the Upper Middle PRM to ensure capture of the PTZ and surrounding LTZ, which is approximately 80 feet, resulting in:

$$
\begin{aligned}
Q = kiA, \quad &= 77 \text{ ft day}^{-1} (0.001)\ 120{,}000 \text{ ft}^2 \\
&= 9{,}250 \text{ ft}^3 \text{day}^{-1} \\
&= 70{,}000 \text{ gpd} \\
&= 48 \text{ gpm}
\end{aligned}
$$

The capture zone[2] for each well in a minimal cross-gradient array of five wells is given by:

$$
\begin{aligned}
y_{max} &= Q/(2kbi) \qquad \text{(Fetter, 2001)} \\
&= 2{,}000 \text{ ft}^3\text{day}^{-1}/2(77\text{ft day}^{-1})(0.001)(80) \\
&= 166 \text{ ft}
\end{aligned}
$$

where

y_{max} is the half-width of the capture zone;

Q is the discharge in ft^3day^{-1} from each well, derived as the total aquifer discharge of 48 gpm distributed between five extraction wells each pumping at 10 gpm;

k is the hydraulic conductivity of 77 ft day^{-1};

b is the total saturated thickness of the UMPMR (80 ft); and

i is the hydraulic conductivity (0.001).

The total cone of influence for each well ($2y_{max}$) is 330 feet. The total cross gradient capture zone along the line of five extraction wells is 1,650 feet. The excess 150 feet is accommodated by overlapping cones of influence between each well. These calculations have been added to the text of the FS Report.

95. *Page 3-100, Section 3.5.3.4: The containment extraction wells are proposed upgradient of Swindell Pond. One drawback of this approach is that the source area appears to extend for some unknown distance underneath the pond. Without a presentation of the basis of the 50 gpm rate, it is not clear how much of this portion of the source area would be addressed by this approach. With this and each alternative, a figure should be provided showing the layout of the elements and the area affected.*

Response: Figure 3-7 has been added that illustrates the overlapping containment from the pumping wells in the cross-section. Placement of the containment extraction wells was based on two primary considerations: (1) the concentrations of COCs downgradient of the pond are substantially lower than upgradient (see RI Report, Section 5) indicating that the edge of the PTZ is probably much closer to the upgradient side than the downgradient side and placement of the containment wells in the downgradient edge of the PTZ will yield more mass reduction than downgradient; and (2) logistically, placement of the containment wells on the upgradient side would keep them in close proximity to the treatment plant and away from the wetlands/I-295 implementability issues/concerns.

96. *Page 3-103, Section 3.5.3.4: The enhanced biological injection scheme is proposed as extending 400 feet along strike, centered on MW-11. This would address only a small portion of the center of the plume. The efficacy of such an approach is very questionable.*

Response: Based on the June 28, 2005 discussions with the USEPA, the Committee has extended the injection design across the entire width of the plume along I-295 (approximately 2000 feet (Figure 3-9).

97. *Page 3-103, Section 3.5.3.4, Paragraph 1. As described for Alternative 3.5.3.4, the peroxygen treatment serves as a passive, reactive barrier wall for passing groundwater, rather than direct treatment of the distal downgradient area of the contaminant plume. The peroxygen slurry described cannot be forced into the pore spaces of the Upper Middle PRM Aquifer. Thus, passing groundwater must transport treatment chemicals into downgradient areas of the plume. Minimal hydraulic control of the treatment fluids in downgradient areas of the plume is achieved by situating the injection wells sub-perpendicular to the axis of the plume.*

Response: See responses to general comment #14 and to specific comments #42, 92 and 95, regarding access/implementability in downgradient areas, as well as reasonable time tables for restoration.

98. *Page 3-106, Section 3.5.3.4, Paragraph 1. Although groundwater extraction in the PTZ is solely for hydraulic control, removal of contaminant mass will be achieved during this effort. Subsequently, the statement that no significant improvement in groundwater quality would be achieved by Alternative DGW-4 is invalid.*

Response: The FS Report text has been revised to recognize the limited improvement of ground water quality, given the extraction wells would be located in the downgradient edge of the PTZ.

99. *Page 3-112, Section 3.5.3.4, Paragraph 1. An annual O&M cost of $2,115,000 for a 50 gallon per minute (gpm) groundwater extraction system appears high.*

Response: The relatively high costs are driven primarily by the high TDS and diversity of COCs that must be stringently treated before discharge. A decrease in costs may occur over time due to decreasing influent concentrations. As a result of these factors, a significantly complex treatment train will be required. Four full-time operators will be employed to run the treatment plant; other significant expenditures include the periodic replacement of UV lamps and membrane filters and the disposal of various sludges and filter press materials related to plant operations.

100. *Page 3-113, Section 3.5.3.5, Paragraph 1. This sentence states that a contingency plan is needed in the case that MNA does not achieve RAOs for groundwater. This sentence should reflect that the contingency plan would most likely constitute the implementation of one of the other more active remedial alternatives in Section 3.*

Response: Agreed, a revision to the FS Report text has been made.

101. *Page 3-113, Section 3.5.3.5, Paragraph 1. At a minimum, NJDEP requires the collection of nine quarters of monitoring data before a monitored natural attenuation alternative can be implemented.*

Response: Quarterly monitoring for the first five years has been added to alternative.

102. *Page 3-117 and 3-118. Section 3.5.3.6, Similar to discussion provided in previous comments, no calculations, or output groundwater flow modeling simulations are provided to support the number of extraction wells, employed in Alternative DGW-6. Results of groundwater modeling simulations are the only effective method of evaluating the relatively complicated pumping scheme described on Page 3-118.*

Response: Calculations supporting the text are contained in Attachment 2 of the revised FS Report and new discussion of DGW-6, including additional figures. More detailed ground water modeling would be completed as part of remedial design but is not necessary to complete the alternative evaluation.

103. *Page 3-119, Section 3.5.3.6: The alternative is scoped as requiring one third of the ISCO injection in previous alternatives - as a result of extracting one pore volume of groundwater. This is not a realistic assumption. The primary benefit of peroxide would be reductions in mass in the higher conductivity zones - as well as some limited effect on the finer grained units. (Fine grained units might see*

more benefit from a longer lived oxidant). The area which would need to be treated is very likely to be the same after removing one pore volume. In fact, the program laid out in the attachment includes application over the full area after the pore volume is removed. Costing of this alternative would need to include injection on the same scale as injection without pre-pumping. The amount of oxidant might be less, given some mass removal, but otherwise the costs would be similar. There is no reason to believe that two thirds of the area will be cleaned up by pumping a single pore volume of groundwater.

Response: As discussed and agreed upon at the June 28, 2005 meeting with the USEPA, the scoping of the ISCO is nearly identical to Alternative 3B in terms of number of injection wells, but decreased in scope by 33% for treatment reagents following the initial ground water pumping and treatment and subsequent monitoring.

104. Page 3-122, Section 3.5.3.6, Paragraph 3. Earlier descriptions of Alternative DGW-6 indicate one pore volume of water will be extracted from the PTZ for treatment. However, in the evaluation of costs, the Draft FS mentions extracting two pore volumes. The description of Alternative DGW-6 should be made consistent throughout the evaluation of the nine criteria.

Response: The second pore volume is included to facilitate the distribution of the initial ISCO application. A third potential pore volume has been added to facilitate distribution of a second ISCO application. Revisions to the FS Report text have been made accordingly.

105. Page 3-123, Section 3.5.3.6, Paragraph 1. The Draft FS should identify the length of the post treatment, monitoring period for Alternative DGW-6.

Response: As shown on Figure 4-1, monitoring would be conducted for approximately 14 years following enhanced biological treatment of the LTZ and PTZ and 20 years from the completion of ISCO. A revision to the FS Report text has been made accordingly.

106. Page 3-126, Section 3.5.3.7: It is not reasonable to assume that DGW-7 would be more expensive and DGW-6. Enhanced biodegradation would have nearly identical sampling needs as un-enhanced MNA. The difference in cost would therefore be only from the cost of the injections.

Response: As reported in the draft FS Report (BROS Technical Committee, 2005c). the difference in costs between DGW-6 and DGW-7 was previously a direct result of costs related to installation of additional interior monitoring wells for MNA evaluation and associated increases in engineering oversight/construction management and overall contingency costs. Alternatives DGW-6 and DGW-7 have been revised consistent with EPA comments and discussions. The number of bioenhancement injection wells for DGW-6 has increased substantially, which has resulted in greater costs, while the MNA costs for DGW-7 have increased only a relatively small amount. Therefore, the cost to implement Alternative DGW-6 is substantially greater than DGW-7.

107. *Table 3-1. In accordance with EPA guidelines, the list of compounds within the RAOs is the list of COCs, not the list of COPCs as presented in the bullet one. In Table 3-1, the COCs for deep groundwater should be included, rather than the summary (i.e. VOCs, SVOCs, metals, etc.) currently in Table 3-1.*

Response: See response to general comments #5 and 6.

108. *Table 3-2. Clearly state that the volume of water used for calculation purposes is the area with site-specific COCs over the applicable PRGs.*

Response: A revision has been made to reflect this comment.

109. *Table 3-7, Alternative 4A. In row 3 and note #3, it states that Alternative 4A is similar in short-term effectiveness as Alternative 2A. It is agreed that pump and treatment for groundwater plumes may be ineffective over the long-term, Alternative 2A will remove a larger mass of impacted groundwater in the short-term over Alternative 4A. Therefore, the short-term effectiveness for Alternative 4A should be lower than Alternative 2A. If this change is made, it will rank Alternative 2A higher than 4A. Based on this change, consideration should be made to retain Alternative 2A for detailed evaluation later in Section 3.*

Response: The Committee reviewed the USEPA's comment and notes that both 2A and 4A ranked close to the no further action alternative and substantially less than the more highly ranked alternatives. In addition, the amount of pumping and treatment in 2A and 4A is very similar in magnitude and duration. Consequently, no revision has been made in response to this comment.

110. *Tables 3-9 and 3-10. There is little difference in the capital and O&M costs for these two alternatives. There does not appear to be costs included (as are for Alternatives DGW4 and DGW-6) for the installation of the downgradient injection wells. Also, the contingency cost for capital costs is different (25 percent) in alternative DGW-2 than all other alternatives.*

Response: The capital costs are similar because the ISCO injection wells will be used subsequently for enhanced biodegradation injections (and only bionutrients and NaOH will be injected) – limited additional capital costs will be incurred. O & M costs are similar because the performance monitoring program for MNA and enhanced biodegradation will be similar. Contingency costs are elevated for DGW-2 to address uncertainties related to the enhanced biodegradation component.

111. *Tables 3-11 and 3-13. Although these alternatives include the same basis capital costs for installation (with the exception of injection wells downgradient), the costs for final design, engineering, workplan development, and mobilization/demobilization are much higher in Table 3-13.*

Response: The costs for final design/engineering, workplan development, and mobilization/demobilization for DGW-4 and DGW-5 are presented below:

Component	DGW-4/Table 3-11	DGW-5/Table 3-13
Engineering	$200,000	$100,000
Work Plan	$120,000	$75,000
Mob/Demob	$40,000	$25,000

As illustrated above and presented in the Draft FS Report (BROS Technical Committee, 2004), the costs for DGW-4 (Table 3-11) are higher than DGW-5 (Table 3-13); the increased costs are related to downgradient injection wells. Note that costs for DGW-4 in the Revised Draft FS Report have increased (relative to the costs in the Draft FS Report) due to the increase in the number of downgradient injection wells: Engineering-$250,000; Work Plan - $150,000; and

112. *Figures 1-11 and 1-12. In addition to geographic location of points on the graphs, appropriate monitoring well numbers should also be provided.*

Response: Similar to the revised RI Report, Figure 1-13 has been added to clarify Figures 1-11 and 1-12.

113. *Figure 1-13. In accordance with General Comment #11, this figure illustrates the PTZ in deep groundwater related to TCE and benzene. This figure should also illustrate the concentrations of other COCs (such as BCEE) that designate the PTZ area.*

Response: See response to general comment #11. In addition, plates 8, 9 and 10 of the RI Report provide figures illustrating the distribution of all COCs in and around the PTZ area.

114. *Figure 1-13. This figure illustrates the concentrations of benzene and TCE in groundwater at the based of the Upper PRM Aquifer. One the figure, there is isoconcentration gradients designated as "estimated total benzene and TCE concentrations". However, monitoring well MW-33D, along the southern side of the site, has not been included in the isoconcentration gradients. This well has demonstrated concentrations of TCE between 5 and 10 ug/L, however, this well is outside of the 1 ug/L contour.*

Response: As discussed with the USEPA on several occasions over the last several years, there is considerable uncertainty regarding the source of the low level TCE concentrations detected in MW-33D. Based on ground water flow analysis and the lack of other COCs, the Committee has concluded that the TCE in MW-33D is likely a result of another source, such as the Chemical Leaman Site. Nonetheless, the Committee has committed to install three additional sentinel wells south of I-295, in the vicinity of MW-33D (see Section 3.5.3). In addition, all of the homes in the vicinity of MW-33D have been connected to the newly installed water line in that area.

ATTACHMENT 1:

1. *Delivery issues: There are a number of assumptions in oxidant delivery that are not well justified or are likely overly optimistic. Subsequently, there is doubt over whether the approach is properly scoped and whether it will be possible to treat the entire area. The following issues pertain:*

   a. *Simultaneous pumping and injection is assumed to result in oxidant distribution that extends 120 ft from the injection point, compared to 20 to 40 feet perpendicular to flow. Pumping rates to achieve this have been presented, but the basis for the rates and the resulting oxidant distribution are not given. If this was based on a modeling exercise using the site groundwater model, some information on that exercise needs to be provided in justification. This explanation also needs to be integrated with longevity of oxidant activity and the contention that removing one pore volume of water from the area will take 4 to 6 months. Peroxide activity generally lasts for a period of hours to days. If it takes months to flush one pore volume of water, it seems likely that these pumping rates would not induce sufficient gradients to achieve the assumed distribution.*

      Page 13 suggests pumping at reduced rates of 2 gpm during the second injection. The presumption that oxidant could be delivered on a 20 foot spacing crossgradient and effect areas 80 downgradient is not realistic - especially with such a low pumping rate. The text does not indicate how this rate was selected or what the anticipated impact would be.

Response: The amount of detail contained in the conceptual design is consistent with relevant literature and the known properties of the aquifer. Additional discussion and detail has been added to the text of the FS Report. Based on these considerations and the fact that the commenter provided no support for their contentions, the Committee did not make additional specific revisions in response to this comment. As noted in response to specific comments on the FS Report text, the Committee has substantially increased the number of injection points and reaffirmed its commitment to complete the necessary pilot studies.

   b. *The vertical distribution of oxidant may also be problematic. The conceptual approach suggests injection over 5 to 10 feet of the 20 foot zone. With assumed differences in vertical and horizontal hydraulic conductivity, distribution to areas above and below an injection interval is likely to be limited. The report argues that downwards vertical gradients are present and could be enhanced by the pumping, but the directional conductivity differences and the head from injection are likely to dominate. Also, with the production of hot gas that will likely rise, upwards transport of oxidant seems more likely. A more convincing argument is needed here - or oxidant injection over the full area to be* *impacted should be considered.*

Response: The factors raised in the comment were considered in some detail by the Committee, as should be evident by Attachment 2 (former Attachment 1) and detailed supporting stratigraphic figures. More detailed considerations of these factors would be appropriately considered in the Pilot Study Work Plan and design documents.

c. Given the short lived activity of hydroxyl radicals, the arguments for oxidant infiltration into finer grained layers need to be better supported. It is suggested that reagent can be pooled on lower conductivity layers, allowing it to infiltrate. It is further estimated that infiltration will be greater with each application. The text seems to argue that density driven infiltration would be significant - but this seems unlikely as higher density material will pool rather than quickly infiltrate. If diffusive mechanisms are presumed to be the dominant means of infiltration, then the short lived activity of the oxidant will prevent effective treatment - and it is not clear that sequential applications would result in improved infiltration.

Response: This issue has been addressed by other specific comment # 72; and responses to comments 3 and 4 Attachment 1 of draft FS and associated FS Report text changes. In addition, the FS Report does not preclude the potential application of another oxidant such as potassium permanganate in small areas or particular stratigraphic interfaces where significant rebound occurs following two applications of Fenton's reagent. However, this contingency is not specifically scoped at this time but retained as an option under the adaptive site management approach.

d. Application of oxidants to the 'downgradient sub-zone' appears to be fairly problematic. Delineation of its southern and eastern extent has not been practical because of the presence of the pond and swamp. Significant source is likely to underlie these areas and it will not be possible to include them in the effort. This will leave some of the most downgradient portions of the source area untreated. The density of delivery points in the remainder of this sub-zone is also considerably less than in other areas. An attempt to justify this is made based on local stratigraphy - but given the distribution issues discussed above, it seems unlikely that even the accessible portion of the sub-zone will be effectively treated by the plan as presented.

Response: The issue raised in this comment is largely a design issue and sufficient contingency budgeting is included to assure the final design addresses the problem. In addition, to the extent that elevated PTZ concentrations extend below a portion of the pond, this condition will be an issue with all technologies to some degree. From a practical standpoint, the distribution of the PTZ beneath the pond is probably overstated given the substantial decrease in concentrations of all COCs from the north side to the south side of the pond (Figures 1-11, 1-12 and 1-13).

e. *The text argues that advective flow will continue to deliver reagent to the downgradient sub-zone. Given the short period of reactivity for peroxide, this is not likely to happen.*

Response: The text has been revised to clarify that as a result of the ISCO reduction of COD and BOD, oxidizing conditions would be stabilized and increased in the downgradient area. See the response to part C of this comment also regarding other oxidizers.

2. *Table 1: The methods used to calculate the effectiveness of pumping are not clearly presented and appear to be somewhat problematic. It appears that each pore volume removed is presented without any consideration of repartitioning between media. The initial values for partitioning are based on Kd values, but after each pore volume is removed, the ratios become more skewed. For example, before any pumping, 86% of the TCE is shown to be in the groundwater of the sand unit. After one pore volume, 61% of the mass is in the groundwater - and after 2 pore volumes, 28% of the mass in is groundwater. This is unrealistic as TCE would continue to partition to the groundwater. Although the time to reach equilibrium repartitioning may be hard to define, a considerable amount would occur in the 4 to 6 months modeled for the removal of the first pore volume. Instead, removal efficiencies were selected purely on the basis of professional judgment (as indicated in Note 9 of the table) and applied to each pore volume without readjusting the mass in each media (say, using a batch flushing model). The result of this approach is to underestimate of the effectiveness of pumping.*

Response: Partitioning throughout the assumed pumping scenario was factored into the calculations. However, in the example in Attachment 1 in the draft FS Report (Attachment 2 in draft revised FS Report), the pumping is assumed to be continuous and the concentrations in ground water do not have time to return to an equilibrium state because removal is ongoing. The advantages of pulsed pumping could be evaluated as part of the design of the pumping and treatment portion of the LTZ area remediation. In the example (Attachment 2), the removal efficiency of pumping and treatment is overestimated because recovery efficiency from the aquifer was assumed to be constant through each pore volume removal despite decreasing concentrations in the aquifer during pumping.

3. *Table 2: Oxidation efficiencies are also based purely on professional judgment - and are even harder to justify. Furthermore, the main advantage of oxidation that is brought out in the table is that oxidation is presumed to have a more significant effect on the mass within the fine grained layers. While it is agreed that there is some potential for this to be true, peroxide is unlikely to successfully infiltrate the fine grained layers due to its short period of activity. Uniform delivery to the sands and gravels is similarly in question. Permanganate, for example, is much more long lived and would have a much greater potential for infiltration.*

Response: The oxidation efficiencies are consistent with the Treatability Studies and literature. As noted in the response to Comment 1d on Attachment 1, permanganate could be considered for recalcitrant areas following two applications of Fenton's reagent. However, given the current subsurface conditions (pH and iron concentrations) are ideal for Fenton's reactions, the most effective oxidant initially in reducing COC mass would be Fenton's reagent.

4. *Setting aside the problems with the calculations on Tables 1 and 2, the presented results show that the main difference between the two approaches is that oxidation is projected to remove an extra 25 lbs of TCE from the soils. The majority of the mass in the silt and clay units will remain and continue to be a source to groundwater. The difference in residual mass is unlikely to result in a major difference in concentrations of groundwater after rebound. Diffusion from the fine grain units in either case will control groundwater concentrations. Given the linked problems of delivery and the longevity of peroxide, as well as the fact that southern and eastern portions of the source area will not be treated by oxidation, pumping may be the better approach.*

   One alternative that might bear consideration, is implementing the source area pumping scheme and running it until concentrations become asymptotic (rather than for a single pore volume). At that point, the system might be scaled back to a containment approach - and a long lasting oxidant, such as permanganate, might be applied to areas where it could have an effect on the fine grained materials. Given the difficulty in predicting equilibrium kinetics (and given the site complexities), the amount of pumping needed to identify hot rebound areas or to reach concentration asymptotes can not be accurately predetermined.

   It may also be reasonable to build in the flexibility to alternate the pumping levels. A period of aggressive rates would remove the fraction dissolved in groundwater. A subsequent period of containment pumping would allow the system to return to partitioning equilibrium, where the majority of the mass in the conductive units would again be found in the groundwater. A subsequent period of higher pumping could then ensue, and be more effective at mass removal. An alternative such as this could also include an oxidation element to address any hot areas. This is similar to the sequencing approaches in Alternative 5, but would allow the phasing to be guided by empirical evidence rather than the extraction of set volumes.

   In weighing the benefits of the first pore volume extraction, it would be worthwhile to understand how much less oxidant (and the cost savings) would be needed as a result of the effort. Removal of the contaminant mass in the first pore volume would reduce the amount of contamination that the oxidant would need to address. However, it is not clear that the savings in oxidant costs would be greater than the cost of the pump and treat effort.

   The modeling in Attachment 1 illustrates that the majority of the mass is present in the groundwater, and that the greatest mass sorbed to soils is likely to be present in the conductive zones. The mass estimates in the lower conductivity *units are better considered as maxima, as the actual numbers would be based on the distance that contaminants had diffused into those units. Diffusion into the basal clay unit on which the contamination rests is not included and also is likely to represent a major long term source for back diffusion.*

Response: The Committee and its consultants (including several independent reviewers with relevant expertise) evaluated numerous remedial scenarios over the last four years, taking into consideration each of the factors raised in the comment. The combination of approaches included in several remedial alternatives were assembled because, but not limited to:

- the CERCLA/NCP preference for treatment of a principal threat area;
- the existing conditions in the PTZ and the Treatability Studies support using Fenton's reagent to treat COC mass;
- pumping and treatment (up to three pore volumes) concurrent with ISCO is utilized to initially reduce COC concentrations to optimize ISCO effectiveness in all subsurface strata, as well as distribute the oxidizing agent;
- more aggressive initial pumping and treatment would eliminate the existing conditions such that Fenton's reagent would be less efficient and require pH/iron adjustments; and
- using a combination of pumping and treatment, ISCO and enhanced biodegradation is preferred under the relevant USEPA guidance because a combination of technologies will yield higher levels of effectiveness for differing reasons that in the end result is the most complete restoration.